

Biofeedback protocols for BrainBay software (v. 1.2)

Preface

It is assumed, that you have basic idea about neurofeedback (<http://www.neurobitsystems.com/neurofeedback.htm>) and you have familiarized with instruction manual of an owned device, as well as with instructions of EEG electrode application (available at http://www.neurobitsystems.com/download/Application_of_EEG_electrodes.pdf).

In order to use described protocols, free BrainBay application v. 1.8 is necessary. It can be downloaded from the website <http://www.shifz.org/brainbay/>. (Note: Future versions of the application may require an upgrade of this protocol package.)

Installation of the training protocols consists in unpacking of delivered archive in folder of BrainBay installation (typically "C:\Program Files\BrainBay"), preserving subdirectory structure.

For Neurobit Optima device a computer should be equipped with built-in Bluetooth port or correctly installed Bluetooth adapter in USB port, and the device should be paired with a computer. (For Neurobit Lite device IrDA port or adapter is required for communication with a computer.)

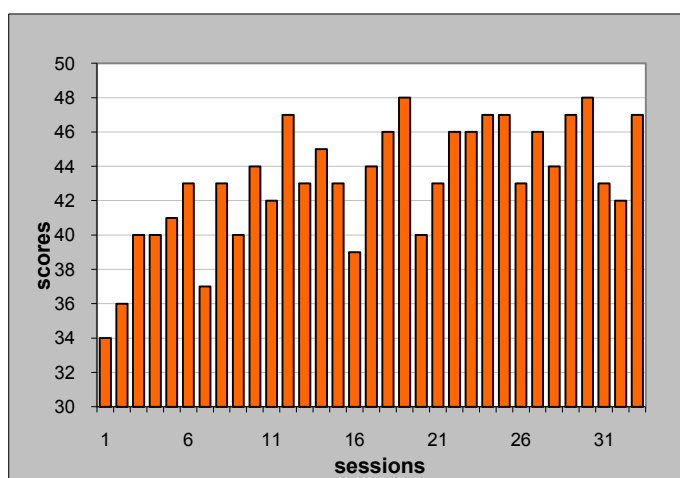
Neurofeedback protocols

Introduction

You need at least a quarter-hour for the training. The session for a given protocol usually takes from a few minutes to a few dozen minutes. However, for the first training, plan more time (e.g. an hour). Trainings are typically repeated every other day.

Peak performance training is the field for long-term exploration. The series of trainings usually consists of 3 phases:

1. At the first stage, from a few to about a dozen sessions, gradual increase in the trained parameter (e.g. contents of some brainwave) usually occurs. Just a few per cent of lasting increase may mean a substantial improvement in functioning. The process of learning takes place both consciously and by unconscious mechanisms.



An example of score trend in series of sessions.

2. Level and character of brain functioning is influenced by numerous internal and external factors, including quantity and quality of sleep, physical activity, stress, interpersonal relations, kind of work, and intensity and color of light. The purpose of the second phase of

the training series, including typically about a dozen to a few dozen sessions, is to limit result variations linked with those influences and to stabilize scores at a higher level. The purpose of this stage is also gradual growth in control skills of psychological states in daily situations beyond the sessions. In ordinary circumstances (at work, in the street, during sports, with family), try not to "lose sight" of the mind state and to correct it in accordance with needs, in the manner learned in sessions. For example, in circumstances associated with serious stress, try to find (to reproduce) that internal calmness and distance which you were able to experience during the sessions with Focus protocol.

3. The third phase of the series is strengthening the skills that you have gained. It may turn into a constant practice, allowing compensation for the influence of various unfavorable existential factors. Further subtle (or sometimes leaping) quality changes may occur in mind functioning. Trainings can be done more rarely, for example once a week, as well as before or after more serious challenges (e.g. public speeches, key meetings, examinations). It is also possible to connect neurofeedback with other methods of personal development, such as meditation. This usually gives quicker and better effects than applying those methods separately.

Session start

In order to use a given protocol:

1. Start BrainBay application.
2. With Design/"Load design" option from the main menu of the application, load suitable design file from subfolder CONFIGURATIONS\Neurobit\Training\{device model}.
3. Apply and connect electrodes according to a given protocol.
For neurofeedback the standard electrodes delivered in the set with the device are used. Typically referential derivations are applied (with reference electrode on the right earlobe connected to "-" inputs of used channels), with VG electrode (SUM for Neurobit Lite) on the left earlobe. For one channel measurement the use of channel A is assumed.
For two channel measurements an electrode placed on the left head side (for example in C₃ site) should be connected to channel A (A+ input), and the electrode applied on the right side (for example in C₄ site) is connected to channel B (B+ input). In that case inputs A- and B- are connected with suitable splitter to reference electrode.
4. Turn on the device and place it in wireless communication range.
5. If you use Neurobit Optima device, which enables test of input connections on a computer, it is recommended to check electrical contacts between electrodes and skin right after application of the electrodes:
 - a. Select Options/"Device settings" in the main menu.
 - b. In signal source properties window click the button "Change Device Configuration".
 - c. In appearing device settings window select Test tab and click Test button. Signal controls and impedance bar indicators should be green (or yellow after all). If some of them are red, electrode application should be corrected, according to hints in a separate document. (Detailed information concerning Test tab can be found in help available on About tab of the device settings window.)
 - d. Successfully done test is finished with Stop button. (Then close device settings window and source properties window.)

6. Run the training session with Play button on the application status bar (or with F7 key).

The session can be paused with Stop button on the application status bar (or with F8 key). In order to finish the session we recommend to use Reset button on the status bar.

Training interface

For typical neurofeedback design from the package, the application window includes:

- session time (usually near left bottom corner of the application window),
- one or more panels of feedback signals (scores). A panel includes bar graph (with dynamically set threshold), digital displays of current score and average result since the beginning of the session.

Scores are typically calculated on the basis of brainwave relative amplitudes in rewarded frequency band compared with amplitudes in whole useful band or a band of waves, which should be suppressed.

- for trainings carried out with opened eyes there is also a window of animation or movie, controlled by scores.

HINT: By default, designs including movie player are connected with example videos delivered with some versions of Windows system. Instead of them, you can use other video files in AVI or WMV format:

1. open the design window (F5 key),
 2. find MEDIAPLAYER element (usually at the right edge of the element network),
 3. click it with right mouse button,
 4. in appearing properties window of that element click “Select MCI File”,
 5. select video file,
 6. in MEDIAPLAYER’s properties window click Open button,
 7. and finally close the properties window and with F5 key hide the design window.
- bar indicators of absolute levels of signals of frequencies below (LF) and over (HF) useful frequency band. Too high absolute levels of those components, as well as too high relative levels in comparison to signal in useful band, usually show about interferences or artifacts and are signaled with warning sounds of steel drum. In such moments the main feedback sounds pause.

LF component is usually connected with unstable electrode-skin contact, body or cable movements or rapid eye movements. HF component is typically caused by EMG signal generated by tensed muscles in the vicinity of electrodes.

Moreover, the current score is signaled with pitch of the sound on the audio output of a computer. (The pitch increases or drops with score increase, depending on a protocol.) It is the main feedback signal for trainings, which should be done with closed eyes.

In protocols using videos, playing starts when current score goes over a dynamic threshold in bar indicator window. (In case of a few scores, all of them should be over the threshold.)

Expiration of a default session time is signaled with a drum sound. Session time counter stops then. Continuation of the training is still possible. However, for protocols rewarding fast brainwaves (frequencies > 15 Hz, as in Energy protocol, for example) the session extension is not recommended.

Apart from indicators and presentations described above, which are directly used during the training, after maximization or extension of the application window additional graphs appear. They may be useful for advanced users:

- frequency spectrum (FFT) of measured signal (usually below the session time window or on the right side of the animation window). Vertical axis represents frequencies of the signal components, whereas horizontal swings correspond to amplitudes of those components.
- trend of score(s) during the session,
- time graph of measured signal.

Review of neurofeedback protocols

Protocol	Range of effects	Remarks
Depth	<ul style="list-style-type: none"> • deep relaxation • mind/body integration • self-regulation • meditation • imagery 	Good especially when you feel exhausted or your body is unregulated. Session is done with closed eyes, maybe additionally covered with hand or in dimmed place. You can sit or lie down. Good time is the middle of daily activity period.
Alpha-Theta	<ul style="list-style-type: none"> • visualization • meditation • creativity • art performance • access to normally unconscious contents • recovery from trauma and addictions • mind/body integration 	Session is done with closed eyes, usually reclining or with meditative posture. Recommended in periods, when you face some psychological challenges. Or regularly, for better performance and as a support in meditation.
Relax	<ul style="list-style-type: none"> • general mental relax • immunity to stress • reduction in physiological stress effects • freedom from fear • creativity • memory 	Suitable in the afternoon. Session is done with closed eyes. Recommended especially, when you are feeling burn out, overloaded, annoyed, anxious or you are experiencing "races of thoughts". Also after serious mental challenges.
Focus	<ul style="list-style-type: none"> • inner concentration • focus on goal • psychological endurance • freedom from fear and stage fright • self-confidence • self-awareness • memory 	The protocol particularly adequate before public speeches, important meetings, sports achievements.
Peak	<ul style="list-style-type: none"> • integration of senses and thoughts • emotional intelligence • sensual sensitivity • self-control • bright mood 	The training recommended, among other things, for improvement in interpersonal relations, before negotiations or artistic performance.
Attention	<ul style="list-style-type: none"> • attention • perceptiveness • reduced number of errors • learning • making decisions • reaction time 	The protocol recommended especially if you learn, study, or if you are sometimes inattentive.
Language	<ul style="list-style-type: none"> • speech recognition • ability to associate • attentive listening 	
Energy	<ul style="list-style-type: none"> • alertness • attention • reaction time • efficient operation • concentration on surroundings • resolution of complex problems 	The protocol suitable in the morning, when a lot of matters await you.
Clarity	Similarly as above for Attention protocol, but better matched with specificity of both brain hemispheres.	
Synchrony	<ul style="list-style-type: none"> • synchronization of brain hemispheres • mind clarity • inner peace • easy transition to other states 	The training recommended both in the morning, as well as in about 9 h after awakening.
Monitor	General evaluation of measured EEG signal, artifact influence, as well as for educational applications.	
Mirror	Additional help in self-awareness and self-improvement for advanced users of neurofeedback.	

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Protocol	Head electrode site(s)	Conditions	Rewarded frequency band (Hz)†	Suppressed frequency band (Hz)‡	Def, session time (min)	Musical instrument	Pitch direction	Visual presentation*	Goal
Depth	Cz or Pz	eyes closed	6-9	3-5,5	45	FX 6 (6-9 Hz), Xylophone (warn.)	downward (higher the score, lower the pitch)	-	pitch drop, but without warning sound
Alpha-Theta	Pz or Cz	eyes closed	5,5-8; 8-11	3-5,5	45	Pad 5 (theta), Sitar (alpha), Wood block (transition)	downward	-	drop of sitar pitch, next time balance of both instruments
Relax	Pz or CPz	eyes closed	8-11	-	30	Flute	downward	-	pitch drop
Focus	Pz or CPz	eyes opened	10-13	-	15	Music box	upward (higher the score, higher the pitch)	animation	reduction of an object, pitch raise
Peak	Cz, CPz or C ₄	eyes opened	12-15	-	10	Acoustic guitar, FX 7 over thres.	upward	animation	filling with objects as large area as possible
Attention	Cz or CPz	eyes opened	12-15	4-8	10	Harp	upward	video	the most continuous, frequent video playing, pitch raise
Language	F ₇ or T ₃	eyes opened	15-18	4-12	10	Grand piano	upward	video	do.
Energy	C ₃	eyes opened	15-18	-	6	Harpsichord	upward	video	do.
Clarity	C ₃ and C ₄	eyes opened	15-18 @ C ₃ ; 12-15 @ C ₄	-	10	Harp (C ₃), Acoustic guitar (C ₄)	upward	video	do.
Synchrony	T ₃ and T ₄ or C ₃ and C ₄	eyes closed or opened	correlation in 9-11 band	-	30	Synth. voice, FX 3 over thres.	upward	-	pitch raise
Monitor	Cz, Pz or another one	-	-	-	-	Flute (theta), Guitar (alpha), Music box (beta1), Harpsichord (beta2)	This design enables to track EEG changes in basic frequency bands. A band dominating at the moment is signaled with sound of a specific instrument. Sound pitch raises with absolute signal amplitude in that band.		
Mirror	C ₃ and C ₄ or other symmetrical	-	-	-	-	-	This design enables to watch EEG frequency spectrums of both brain hemispheres (so called mind mirror view).		

† Amplitudes in above specified bands are related to total amplitude in the band 4-28Hz.

‡ For most protocols, excessive levels in bands 1-4 and 20-28Hz block main feedback sounds and are signaled with steel drum.

* Apart from graphs and indicators.

General remarks on trainings

- Brain electrical activity measured on the scalp is very tiny (with typical amplitude of a dozen millionths of a volt). It can be easily interfered with artifacts – other physiological or environmental signals, which appear in measured data. Their sources are body motions, measurement cable movements, unstable contacts between sensors and skin, rapid eyeball movements, as well as tension of head, neck and jaw muscles, among other things. Try to avoid such artifacts. Some of them will be signaled with warning sounds. A way to reduce muscle tension may be keeping the head in balanced position (without dominating gravitation to one side), or supporting it with high headrest slightly tilted back, or supporting the head with hands (if it is not against recommendations for a given training protocol).
- The training requires attentive tracing of feedback signals. It consists in modifying internal and external attitudes - by a process of trial and error - in such a way as to reach a higher score and maintain it as long as possible. Attempts can include, for example, supporting the forehead with fingers, focusing sight on a chosen object, keeping eyes half-open, tracing the rhythm of breath, or attentive observation of external sounds. Each of these activities modifies the general mode of the brain operation in a peculiar way (usually not realized). This impact is individualized to some extent, therefore independent attempts play a significant role.
- Pursuing better scores should have the character of a free search. Do not expect to extend the bar indicator with willpower only.
- Processes in the brain progress uninterruptedly, multi-threadedly, and chiefly unconsciously, showing up and fading in the scale of milliseconds. Do not expect that the score will regularly raise, and after reaching the maximum it will remain still. It will fluctuate, often quite suddenly. The goal is to approach high values more frequently and keep them as long as possible.
- Try not to apply particular protocols at random, but instead choose them in accordance with your long-term needs and current level of arousal.
- If you have no special preferences, you can begin to use the device with the Focus protocol, one of the easier practices and possessing a broad spectrum of effects.
- Try to gain a bit of skill for the first protocol before you begin to use the other ones.
- Trainings rewarding fast brainwaves (frequencies > 15 Hz, for example in Energy protocol) should not be done in states of excessive psychological arousal (however, trainings rewarding slow waves will be useful in such circumstances). If headache or nervousness appears during trainings with a given protocol, its use should be limited or discontinued.
- Sessions of a given protocol are usually repeated every 2-3 days. More frequent sessions rewarding fast brainwaves (frequencies > 15 Hz, as in Energy protocol) are not recommended.
- It is necessary to do sessions in a resting position. Avoid sudden or frequent motions, particularly of the head and the measurement cable (they may cause artifacts).
- Scores of consecutive sessions (for a given protocol) are not strictly comparable if the head electrode is not applied in the same place each time.
- Scores obtained for various protocols are not comparable.

- Use of other head electrode sites (than given in protocol table) without consultation with a specialist is not recommended.
- Changes in protocol design, such as modification of connections between elements or changes of element properties by users, which are not biofeedback specialists, are not recommended (apart from modifications suggested in this document). Inappropriate design may be ineffective or may reward undesired brainwaves or artifacts.
- Delivered designs are intended for work with specific sampling frequency (usually 125 or 128 Hz for EEG measurements). It should not be changed (in Neurobit device settings or in general options of BrainBay application).
- Many protocols from the package are close in action to protocols built-in into Neurobit Lite device (for use without a computer). However, due to different implementations, digital scores displayed by Neurobit Lite have different scales.
- Some protocols (Clarity, Synchrony, Mirror) are not available for Neurobit Lite device, because they require two measurement channels.
- The described protocols are intended for psychological training of healthy adults and young people. THESE TRAININGS ARE NOT INTENDED FOR THERAPY.

Hints for selected protocols

Alpha-theta

One of meditative postures can be adopted. Alternatively you can lie down (avoiding pressure on electrodes and cable tension); or you can sit with elbows propped against desktop, with palms covering eyes and leant against forehead and cheeks. The eyes should be closed.

This protocol uses two components simultaneously. Sitar sound represents Alpha waves and electronic instrument corresponds to Theta waves. At the session onset, the sitar mostly predominates. Electronic sound (theta) appears from time to time. Transitions between both brainwaves are signaled by short clatters of wood block.

Follow the sound and try to lower its pitch, emptying the mind from daily thoughts. After reaching calm, empty space inside, invite images. Maybe somebody's face, some object or scene has stuck in your mind recently. Call those snapshots now. Let them flow freely. Sounds will monitor your mind. Within a dozen or so minutes electronic sounds usually become more frequent and images become more vivid. Try to reach and maintain the balance of Alpha and Theta sounds for longer time.

If you feel sleepy, Theta waves will predominate and finally warning sounds of xylophone will appear, helping to restore consciousness.

After about twenty minutes at Alpha-Theta crossover you can softly surface, trying to empty mind and make sitar sounds more frequent and their episodes longer.

This protocol can be also adopted as an aid for meditation.

Relax

Sit in a comfortable place where you will not be disturbed. If you sit at desktop or table, you can prop elbows against it, with palms covering eyes and leant against forehead and cheeks. The eyes should be closed.

Try to free the mind from images flowing in. Do not allow dozens of thoughts to bombard your consciousness with urgent or difficult matters. Not now. If this proves considerably difficult, try to concentrate attention on the rising and falling movements of the chest with a regular, calm breathing rhythm. (If any matters persistently return, pause the session, write them down for later consideration, and then resume the training.)

Look for a space free from thoughts and images. As approaching this target, the flute tones will fall more often and more deeply. Try to extend such states as long as possible. Having reached internal silence, after a dozen or so minutes you can let thoughts wander freely, watching their content as if from a distance and not stopping longer at none of them.

Focus

Find a calm and comfortable place. Do not close your eyes (even if in this manner you might be able to raise the score).

Observe the object in the animation window. Its size fluctuates. Try to reduce it until the object almost completely disappears. When you reaches it, try to keep that state as long as possible. When the object raises again, take next trials. (Instead of focusing sight on the screen you can also try to look at space between you and the object on the screen.)

If you prefer, you can also choose a real object for concentration. Focus your sight on a small, immobile object or an attention-catching environmental detail. For example, this may be a peak visible through your window or the center of neuron icon on the EEG device enclosure. It also may be a selected part of your face reflected in a mirror or a pane, such as an eye or the point between eyes. The selected object should engage only a small fragment of the field of vision and be located no closer than about 0.5 m (20 inches).

You do not need to gaze persistently and without blinking and you do not have to analyze the object. It is essential that it pose some kind of an anchor in the surrounding space for your enduring attention. You can imagine a kind of translucent tunnel between your eyes and the selected object.

Let no importunate thoughts disturb your concentration. Create a calm inner space for focusing. This will be accompanied with the rising sound of the music box. Moments of the best concentration will be filled with sequences of the highest sounds. Try to extend those instants.

Additional help in concentration may include supporting the forehead side surfaces with tips of spread fingers, symmetrically on either side.

Peak

Choose a seat that is firm and not too comfortable.

Observe the animation. Blue objects are continuously thrown from the center. They move in space along bent trajectories depending on brainwaves. When trained waves are small, these objects vanish in the distance fast. Try to keep them nearby for longer time, to fill the whole window with them. As you approach that goal, sound pitch raises.

You can also train watching real environment. Try to reach and maintain simultaneous and intensive consciousness of the surroundings and your own body. At first, try to take in a wide field of vision (as wide as possible), without concentrating sight on any individual objects. The best would be a complex, interesting and variable image, for example a view through your window to the street or a garden moved by gusts of wind.

Watching the surroundings this way at the same time widen the area of perception for your own figure (space occupied by your body). Also encompass touch signals from the body within conscious perception. Experience the touch of the floor with the feet, the surface of pressure on the chair, arrangement of forearms. Follow carefully the feedback sounds. In moments of an increase in the span of aware perception, sounds of the guitar will rise. Try to maintain high tones as long as possible.

It may be helpful to gently connect the tips of spread fingers, with thumbs touching the hollow between the nose and the forehead (and with elbows supported on a tabletop). While continuing observation of the surroundings, try to sense your pulse at the points where fingertips touch.

Peripheral biofeedback protocols

Apart from neurofeedback training, Neurobit Optima devices enable biofeedback using other physiological signals.

In order to measure those signals you need a cable ended with snaps and compatible snap electrodes:

- commonly available, disposable self-adhesive ones (for ECG, surface EMG, etc. signals) or
- disposable disk ones for use with Ten20 conductive-adhesive paste (for ECG, surface EMG etc.),
- finger electrodes with Velcro straps (for GSR).

GSR – Galvanic Skin Response

GSR is connected with level of psycho-physiological arousal (autonomic nervous system arousal). In measured signal two components can be distinguished:

- slowly changing *skin conductance level* (SCL),
- transient *skin conductance response* (SCR).

The arousal can increase under influence of both positive and negative stimuli. When it is excessive as a result of stress, fear etc., the training reducing SCL is purposeful. Apart from that, training reducing SCR appearing after individual stressful (annoying, distracting etc.) stimuli or thoughts is useful. It is used, among other things, for improvement of athletic competition results.

GSR electrodes are fastened on fingers with Velcro straps. Two electrodes connected to “+” and “-” inputs of selected channel (“A” is assumed in delivered BrainBay design) should be placed on volar surface of fingertips (usually index and middle fingers of non-dominating hand) without paste or gel. The electrode connected to VG socket can be placed on the ring finger.

When the design is loaded, the application window includes:

- session time,
- digital displays of session average and current absolute skin conductance in μS (microsiemens),
- bar indicator of absolute conductance in the measurement range 1-20 μS (dark background),
- bar indicator of logarithm of conductance (light background),
- trend of logarithm of conductance.

(Logarithm function enables more adequate representation of reaction to stimuli: the amplitude seen on the logarithm graph corresponds with a reaction strength and does not depend on initial SCL.)

The logarithm of conductance also modulates pitch of feedback sound (higher the conductance, higher the pitch).

Remarks:

- It should be taken into account, that absolute SCL is influenced also by objective physical factors such as ambient temperature, exercise before measurement, type of skin etc. Thus, relative changes of SCL are of more interest than their absolute values.
- SCR appears after some (not all) external stimuli (e.g. when someone unexpectedly claps), somatic events (e.g. deep breath) or mental stimuli (thoughts evoking strong, elementary emotions, negative or positive). More subtle reactions on the level of central nervous system may not appear in skin conductance.
- SCR appears in normal thermoregulation range (may not be seen, when sweat glands are hardly locked due to chill, or oppositely, when they are fully open due to heat). Moreover, a small percentage of people is considered non-responding.
- If measured conductance turns out to exceed the default measurement range (up to 20 μS), the range can be changed. Please select Options/"Device settings" in the main menu, in appearing source properties window click "Change Device Configuration", in device settings window select "Chan A" tab, in "Channel profile" field select "User defined", and next in "Measurement range" field set 160 μS . (Next close device settings window with Close button and source properties window.)

EMG – Electrical activity of muscles

Electromyography (EMG) is measurement of electrical activity of muscle fibers. That activity determines muscle contraction. Biofeedback reinforcing EMG signal is used in rehabilitation and sport. On the other hand, biofeedback training reducing static EMG level can be useful in muscle induced pains, including some types of headaches, and in stress reduction (stress generally increases static muscle tension).

Two electrodes connected to "+" and "-" inputs of a given channel ("A" in delivered design) should be placed on the skin at both ends of selected muscle. Electrode connected to VG port can be placed in the middle of the muscle length (if it is over 10 cm) or in any convenient site of the body (apart from the vicinity of heart).

User interface of the design:

- session time,
- oscilloscope window (with dark background) showing raw EMG signal in used frequency band (80-200 Hz),
- graph of EMG amplitude (in microvolt peak-to-peak) in lower window (light background),
- digital displays of session average and current amplitude (in microvolt peak-to-peak),
- bar indicator of current amplitude.

When EMG amplitude changes, feedback sound is also generated. Its pitch increases with amplitude increase.

Remarks:

- For training reducing static muscle tension (e.g. in muscle pain or stress) higher sensitivity to small EMG amplitude may be required. In such case please open the design window (F5), find the element labeled as „LPF”, with right mouse button click its output port (orange dot), in appearing port properties window, in the field „get from In port” select „none”, and next in central field of the row „Signal range” write down required amplitude range (lower than the default value 1000 μ V), e.g. 200 μ V. (Next close the port properties window and with F5 key hide the design window.)

HR – Heart rate

HR (or pulse) monitoring is used in sport, among other things. In delivered design electrical heart activity (ECG) is used for detection of HR. Electrode placement:

- the first electrode is applied in the vicinity of xiphoid process (lower end of the sternum) and is connected to “A+” input,
- the second electrode is placed on the front surface of the right shoulder and should be connected to “A-” input,
- the third electrode, connected to VG port, may be placed in any convenient body site, for example on the front surface of the left shoulder.

Alternatively, electrodes can be placed correspondingly on the left forearm, the right forearm, the right forearm.

User interface:

- session time,
- measured ECG signal in upper oscilloscope window (dark background),
- digital displays of session average (dark background) and current (light background) heart rate (per minute, updated every heart beat),
- bar indicator of HR, with marked limits of the norm at rest,
- HR trend in lower oscilloscope window (light background).

Ocarina pitch increases with HR increase. Individual heart beats are signaled with drum sound.

Remarks:

- The design is not adjusted to HR monitoring during intense exercise.
- In case of interferences in measurement signal (e.g. due to measurement cable movements or bad electrode contact) results will be incorrect. (If indicator locks at maximum or zero value, the session should be reset and started again.)

TEMP – Skin temperature

Arousal of sympathetic nervous system, e.g. due to stress, cause vasoconstriction and thus reduces surface blood perfusion, especially in extremities. This lowers skin temperature. Biofeedback training increasing temperature counteracts the described effect, enabling to reduce stress level.

Temperature sensor is attached to one of fingers. Typically the probe tip is taped on the dorsal side of a finger with hook & loop strip (soft side of the strip inwards). The tip should stick out of the strip a little (1-2mm). The strip should not grip the finger too much (it would limit blood circulation and lower the temperature).

Two connectors of the sensor cable are connected to “+” and “-” inputs of selected device channel (A channel is assumed in this BrainBay design). If your device has SH port, a lead of cable shield (marked in white) should be connected to it.

User interface:

- session time,
- digital displays of session average and current temperature (in Celsius degrees),
- bar display of temperature changes in current feedback range,
- bar showing the lower limit of current feedback range. The range is 2°C wide and is automatically updated (between 21 to 38 °C), when temperature goes beyond the feedback range.
- temperature trend within last 10 minutes.

Temperature changes in feedback range are mapped into feedback sound pitch (by default, the higher temperature, the lower pitch). Update of feedback range is signaled with wood block clatter.

In normal room temperature, initial finger temperature is usually in the range 27-32°C (and only exceptionally below 22°C). The training session typically takes 15-30 min. The goal is to reach at least 34°C and keep it for 10 minutes. Raising the temperature can be easier e.g. with calm, deep diaphragmatic breath, imagery of being in nice, warm place or imagery that hands get heavy.

Additional info on BrainBay

Recording a session

Apart from real-time data processing and presentation required for the training, BrainBay enables optionally to record measurement signals in archive file for subsequent analysis. In order to start recording, before the session start (or during the session):

1. Select Options/"Device settings" from the main menu.
2. At the bottom of source properties window click the button "Create Archive", give location and name of a file and confirm with Save button.
3. Close source properties window.

Recording can be finished after the session end (or during the session) with "End Recording" button source properties window (Options/"Device settings").

Reproducing a session

If you want to play earlier recorded session in currently opened design:

1. Select Options/"Device settings" from the main menu.
2. In source properties window, in the section "Archive File" click Open, select a file and accept with Open button.
3. Close source properties window.
4. Start playing with Play button on the status bar.
In this case that button will not launch physical measurements in the device, but processing of data from the file, at a rate of regular session.

The file reproduction is ended with Reset button on the status bar. Next open source properties window (Options/"Device settings") and click Close button in the "Archive File" section.

User-created designs

Advanced users interested in creation of their own signal processing designs for BrainBay should read a supplement concerning the use of Neurobit devices in that application:

http://www.neurobitsystems.com/download/Neurobit_in_BrainBay.pdf.

Known issues

1. Some videos used for feedback may seriously slow down signal processing and cause pauses in screen updates. In such cases use videos with lower resolution (and bit rate).
2. Too large window of animation (e.g. in Focus and Peak protocols) may slow down signal processing and delay feedback. To avoid this, enlargement of the animation window is not recommended.
3. If the application status bar (with session control buttons) is not visible, it can be shown with F6 key.
4. Design files are delivered with "read only" attribute. If you want to store possible changes in the design, it should be saved with a new name.