Note:

As this equipment was developed for research purpose use only, you are kindly requested not to use it for other purposes.
Message for users

The equipment is just one that captures a change of blood flow rate in the frontal lobe if it is simply said. It is an indispensable equipment for a brain researcher to challenge the issue of brain function measurement of which importance has risen more and more in the 21st century. However, it also has a possibility in which the examinee may suppose that his/her heart was unwillingly looked into different from the researcher's intention unless it arranges an enough explanation, and carefully considered experimental environment and experimental issues for him/her before the experiment. We strongly hope you to understand and consider the issue when this equipment is used.

If the 20th century is assumed to be the age of shape diagnostics representing CT and MRI, the 21st century may be called the age of functional diagnostics with the equipments such as PET, fMRI, and fNIRS (Near-infrared reflectance spectrometry: Our device is a kind of fNIRS). However, it is said that the functional diagnostics still have a lot of issues to be researched. Understanding such historical background, we developed the Optical Encephalography Spectratech OEG-16 to be of some help for broadening the base of the research.

We agree that there still are a lot of issues that should be improved as an equipment. So, we will welcome the pep talks from you, the brain researchers.

We wish you, the brain researchers the best success in your researches.

Mitsuo Ohashi, President
Spectratech, Inc.
November 8, 2010
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§1 List of functions

When OEG16.exe is started up, the main screen is displayed as follows.

1. **UserProfile** Profile of examinee is created and selected.
2. **Grh Config** Graph position is customized.
3. **Measurement Point Config** Measure point is set.
4. **Event Config** Detail of Event Input is set.
5. **Filter Config** Detail of Filter is set.
6. **OEG-16 Device Control (Sensor Config)** Basic settings of OEG-16 Main unit are set.
7. **Start/Stby** Start/standby of measurement begins.
8. **Stop** Measurement stops.
10. **Cal** Cal screen opens to calibrate.
11. **SoftEvent** Software event starts.
12. **Event List** Measured data stores in PC, etc. are displayed.
13. **Load** Data stored in Spectratech OEG-16 Main unit is read into PC.
14. **CH-Monit** Input status of all hardware channels (Hch) is monitored and displayed.
15. **EXIT** OEG16 software ends.
16. **Version Information** Each version information of the firmware in OEG-16 Main unit and OEG16 software is displayed.
17. **ALL CH DISP** The main screen is displaying the data now, of which graph at optional time is displayed on the main screen and another screen.
Control panel

The following shows the display control panel during measurement, and display of EventList.

**During measurement**

<table>
<thead>
<tr>
<th>Head Display Mode</th>
<th>Oxy/Dxy Range</th>
<th>Time Scroll</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxy</td>
<td>0.5</td>
<td>5 sec</td>
</tr>
<tr>
<td>Decoxy</td>
<td>30</td>
<td></td>
</tr>
</tbody>
</table>

**Filter**

- Moving Average
- None
- Mov
- FFT
- Baseline

**During display of Event List**

<table>
<thead>
<tr>
<th>Head Display Mode</th>
<th>Oxy/Dxy Range</th>
<th>Time Scroll</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxy</td>
<td>0.2</td>
<td>30 sec</td>
</tr>
<tr>
<td>Decoxy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Type (Pseudocolor display method at measure point)**

- Oxy: Change of $\Delta C_{oxyHb}$ is displayed.
- Decoxy: Change of $\Delta C_{deoxyHb}$ is displayed.
- Total: Change of $\Delta C_{totalHb}$ is displayed.

**OxyDxy Range**

Vertical axis of graphical display is set (Unit: mM:mm). For instance, 0.2 displays ±0.2mM:mm in full scale.

**Time Range**

Time width of vertical axis in graphical display is set. It can be set to 30~300 sec/whole width. If MAX is selected when EventList is displayed, whole measurement section is displayed in the entire graph.

**Time Scroll**

- 1s [<][>] Graphical display scrolls in the time axis direction on the second time scale.
- 5s [<<][>>] Graphical display scrolls in the time axis direction on the five seconds time scale.
- [<<<][>>>] Graphical display scrolls in the time axis direction in the set range (Time Range).

**evt**

- [<][>] It is used to move it to the neighboring event when it is selected and displayed by Selected Event in Event List while events exist.

**Filter**

**During measurement:**

- Moving Average It is selected whether it is displayed while moving average filtering process is being done.

**During display of Event List:**

- None It is displayed without filtering process.
- Mov It is displayed after Moving Average processing. Detailed settings are done in Filter Config.
- FFT It is displayed after FFT processing. Detailed settings are done in Filter Config.
- Baseline It is displayed after baseline correction. Detailed settings are done in Filter Config.

When Event List is displayed, it redisplay in pseudocolor at the measurement point (on the background image).

- Replay at 1X speed
- Replay at 10X speed
- Temporary stop
- Stop

**O,D,O+D**

It specifies what is displayed on the graphical display.

- O: $\Delta C_{oxyHb}$ is displayed.
- D: $\Delta C_{deoxyHb}$ is displayed.
- O+D: $\Delta C_{totalHb}$ is displayed.
§2 Flow of process

Please confirm the flow of all processing of OEG16.exe.

[Schematic diagram of the flow of process]
§3 Setup

Grh Config

Graph Position
The desired display form of the graph can be selected. When the Center is selected, the Layout can be adjusted further in detail. The Width can adjust the width and the height of each graph, and the Height can do the entire position (Up, Right, Left, Down).

Graph Display Mode
Original Signal: It is selected to display the graphical display on the MAIN screen with the wavelength data (raw data).
OxyHb/DeoxyHb/TotalHb: It is selected to display the graphical display on the MAIN screen with the concentration change length data of hemoglobin.

The unit is mM, and it can select ±0.005~±10.0 in a full range on the vertical axis. The unit given here will be the default value when a measurement is started.

Time Range (sec)
The time width in the graphical display is set. It can set 30~300sec. The unit given here will be the default value when a measurement is started.
**Event Configuration**

Here, the event condition at measurement is set.

**Event Mode**

Event Related or Block Design is selected. The operation of each mode is shown in the yellow part in the above figure.

It should be used usually in this mode because the Block Design being called in the optical encephalography world is often understood as the repetitive operation of T1 and T2 in this Event Related mode.

The Block Design used in the above figure corresponds to the method in the world where it is utilized together with EEG (Electroencephalography).

(The Block Design Mode will be provided later.)

**Event Timing (Both Mode)**

**Auto**: The mode in which it is started up in Event1 (SoftEvent/Start button in the OEG16 MAIN screen). The event is automatically issued repeatedly after that.

- T0: Initial REST time (0~60sec) is set. "0sec" for no T0.
- T1: TASK time (1~180sec) is set.
- T2: REST time (1~180sec) is set.

**Manual**: The mode in which the event is input from external factor.

Five kinds of external factors are prepared.

- Event1: SoftEvent/Start button in the OEG16 MAIN screen
- Event2: Event button on the front side of Spectratech OEG16 Main unit
- Event3: Input from REMOTE terminal on the back side of Spectratech OEG16 Main unit
- Event4: Input from Ext-Event IN2 terminal on the back side of Spectratech OEG16 Main unit
- Event5: Input from Ext-Event IN1 terminal on the back side of Spectratech OEG16 Main unit

- T0: Event is selected from (Event1~Event5, none). none for no T0.
- T1: Event is selected from (Event1~Event5).
- T2: Event is selected from (Event1~10sec, (T2)sec). The elapsed time from an event generation at T1 can be selected for T2 besides an external factor. 1~10sec is prepared as standard. If it is not sufficient, or optional time is required, select (T2)sec in this T2, and set an optional time into the (T2) window right below.

In addition, the maximum number of issuable events per measurement is 100 times for both Auto and Manual.

**UDP**: Mode to input Event signal from the network by UDP-IN function.

The event signal sent from the application software developed according to the rule described in User Manual - Applied Technology Edition V1.2 is accepted on the same network as the PC on which OEG16.exe is operating.

An optional Event number of 1~127 in decimal notation can be given to the event signal, and each has the following meaning:

- 1~49: It is interpreted as T1 by Spectratech OEG16
- 50~99: It is interpreted as T2 by Spectratech OEG16
- 100~109: It is interpreted as T0 by Spectratech OEG16
- 110~127: It is interpreted just as Event signal by Spectratech OEG16
**Event Sequence T1: Base Reset (real Time Disp)**

When this checkbox was checked, it displays while resetting Base at the time of T1 generation when measuring. (See the position marked with blue circle.)

Example without Base Reset

Example with Base Reset

**Setting of Event Related Example 1**

In Auto mode, when

- T0 10 sec
- T1 20 sec
- T2 15 sec

were set.

T0(Event1) was generated at this point.

To be continued up to STOP
Setting of Event Related  Example 2

In Manual mode, when
T0  none
T1  Event3
T2  6 sec
were set.

Event-related setting  Example 3

In case of UDP mode setting

It is automatically sorted to T0, T1, and T2 according to the value of Event number sent from UDP, interpreted, and accepted.
Filter Configuration

Here, it sets the details of Filter in the control panel on the MAIN screen.

Filter Type
The default where it displays when a measurement ended, or the data read out from Event List in graph on the MAIN screen:
- None: It displays without filtering process.
- Moving Average: It displays after moving average filtering process.
- FFT: It displays after FFT filtering process.

Moving Average
Realtime Moving Average
Turn it on to display while processing moving average when measuring it. When a measurement is started, it is treated as default. Of course, it is possible to turn it on and off from the control panel on the MAIN screen while measuring it. It is displayed a little bit behind real time because of being displayed as processing the moving average while measuring it.

Data Points
It selects a data number (3, 5, 7, 9, 11) for processing the moving average.
Example: Equation when “5” is selected: newD(t0)={D(t-2)+D(t-1)+D(t0)+D(t+1)+D(t+2)}/5

Repeat Times
In the above, repeat count (1~5) of the moving average processing is selected. It is usually used with “1” though it is prepared for the signal with very strong noise.

FFT

Low Pass (Low-pass filter)
The signal at set Freq or less is passed. And, the inclination is set with Slope(dB/Oct).

High Pass (High-pass filter)
The signal at set Freq or above is passed. And, the inclination is set with Slope(dB/Oct).

Band Pass (Band-pass filter)
The signal in the set range (Freq>= ~ Freq<=) is passed. And, the inclination is set with Slope(dB/Oct).

Band Elimination (Band cutoff filter)
The signal in the set ranges (Freq1>= ~ Freq1<=) and (Freq2>= ~ Freq2<=) is cut off. And, the inclination is set with Slope(dB/Oct).

Note:
The unit of frequency is Hz, and FFT is processed to the wavelength data (raw data). And, the concentration change length data of oxyhemoglobin is calculated after FFT processing. The FFT processing after converted into a concentration change length data of oxyhemoglobin is being planned for the future.
Base Line Correct

Correct On/Correct Off
It selects whether it displays after baseline was corrected or not.

Order(Curve Fitting)
1(Linear Fit) Baseline correction process by linear interpolation
2(Polynomial Fit) Baseline correction process by quadratic curve interpolation
3(Polynomial Fit) Baseline correction process by cubic curve interpolation

Example:

Display without baseline processing

Display after baseline correction by linear interpolation

The further, detailed settings are necessary for the baseline correction processing. The detailed settings are explained in the paragraph of Main Window Display Mode in the EventList screen. Here, please be understood that it is briefly directed whether a baseline processing should be done or not, and if to be done which interpolation curve should be used.

Note: The baseline correction processing is done after it was converted into the concentration change length data of oxyhemoglobin.
§4 Measurement

After the preceding Chapter (§3 Setup) was completed, then the measurement work will be started.

User Profile

In the User Profile, it selects or newly creates examinee to be measured. A specific examinee, who is already registered in the Current User can be selected from the examinee list. A new examinee is registered in the New User.

Current User

A specific examinee already registered is selected from the examinee list. Press the OK button when a selection was completed. The following measured data is stored in this examinee file.

New User

Examinee information is newly created. "Name", "Age", "Gender", and "Dominant hand" (right-handed or left-handed) are registered. Press the OK button when the registration was completed. The following measured data is stored in this examinee file.

DATA Folder

When examinees are registered here, a folder that consists of the examinees' names is created in the DATA Folder in the OEG16 folder where OEG16.exe exists. The following measured wavelength data (raw data, TXT file) will be stored in this folder.
Cal

After completion of mounting the head module (sensor band and headband) to an examinee's frontal lobe, the Calibration work is implemented to first confirm if the sensors are mounted correctly, and to adjust the gain of sensor at each measure point.

**Calibration Mode**
- **Auto Calibration**: It selects the mode to perform Calibration automatically. This method is used usually.
- **Manual Calibration**: It is the method for the user to assign the gain of each sensor by himself/herself.

**Auto Calibration** (It is activated when the Auto Calibration is selected in the Calibration Mode.)

Auto Calibration Start
- It starts the Auto Calibration. It is completed for about 25 seconds if it is mounted appropriately.

Example: All channels are normal. | Signals of CH1 and CH2 are weak.
---|---
Good: Within Cal Upper Limit and Cal Lower Limit. | Under: Smaller than Cal Lower Limit. (Signal is recorded, but low reliability.)
Over: Larger than Cal Upper Limit. (Signal is recorded, but low reliability.) | Unused: Strongly affected by the strength of other measure points. (Signal is recorded, but low reliability.)

The elapsed time is displayed in the lower left part in the Cal screen. It may be referred as a guide.
Start/Stby

When the Calibration work has ended, this Start/Stby button becomes active, and is ready to start a measurement.

Screen before measurement (Start/Stby button is active.)

Timer operation (Elapsed Time)
The elapsed time from the record beginning can be displayed. The mouse cursor is taken to the background image, it right-clicks, and Elapsed Time Disp is selected. Then, drag it to select Manual(On/Off) or Auto(On/Off).
- Manual: Click to select it, and the Elapsed Time window opens on the MAIN screen. Click it again, or close with [X] in the window.
  The count starts when a measurement is started.
- Auto: When Auto has been selected, the Elapsed Time window opens automatically when Start/Stby is clicked. The count starts when a measurement is started, and it is automatically closed after File Save.

Font: Size, font style, and color, etc. of the font can be changed.
Size of the window can be changed with the mouse as usual. (It must be operated in the Manual mode.)

Start
The following confirmation screen appears when the Start/Stby button is clicked.

Start confirmation screen
The confirmation screen appears when the Start/Stby button is pushed. If Current User has been selected, the relevant examinee’s name is displayed. In addition, the Current User can also be changed at this point.

There are three kinds of methods to start a recording.
- **Start**: It immediately starts with clicking the Start button in the confirmation screen. It is the normal starting method.
- **Standby1**: It starts with pressing down the Start button on the front side of OEG-16 Main unit. It is a starting method when PC operator and the starter to begin an experiment are away from each other, etc.
- **Standby2**: It starts with a trigger input from Ext-Event IN1 on the back side of OEG-16 Main unit. It is a starting method when a recording starts by synchronizing it with an external device.
Screen during measurement

It is being measured.

Waiting status for Standby1
Waiting status for Standby2

If the start condition becomes complete in either waiting state of the above, the screen in the left figure appears and starts a recording.

Stop screen
When it clicks the Stop button on the MAIN screen, or presses the STOP button on the OEG16 Main unit, the end confirmation screen below appears.

Title (or Comment)
Enter any title or comment for the data to be stored as needed.

File Name
A file name to which the time was automatically assigned is displayed. You may change it here if you want to assign a different name.

The Yes button is clicked to store the wavelength data (raw data). After that, it can be called out from Event List, or used by other softwares as TXT file as it is.

§5 Display and analysis of stored data

The measured and stored biological information can be read out from this Event List, and various filtering processes or the average processing can be given to those data to be examined. In addition, the examined and processed concentration change length data of oxyhemoglobin can be output in CSV file. It may be used for further analytical work with other software. The details of CSV format is described in User’s Manual - Applied Technology Edition.

Event List