

Adding and Subtracting Waveforms

using SmartEP

Introduction

For some modes of operation it may be beneficial to acquire multiple recordings:

- In some cases, long recording sessions can lead to either adaptation or patient fatigue; to avoid this, it may be better to acquire multiple recordings and later create a super average.
- To analyze some responses, you may need to subtract one recording from another to see the effects of the change on the response.
- Some research may require the averaging of waveforms from multiple patients into a single grand average before further analysis.

Addition/Subtraction Modes

SmartEP includes two modes of addition and subtraction:

- **Sweep Weighted:** In this mode, the number of sweeps that are inside each recording will contribute a proportional value to the result. Use this mode when wanting to obtain a grand-average. For example, if recording A contains 2 sweeps and has a value of 10 uV at a particular data point, while recording B contains 4 sweeps and has a value of 15 uV at that same point in time, the resulting addition will have a value of 13.3 uV with 6 sweeps at that data point.
- **uV Weighted:** In this mode, the number of sweeps of the recordings do not matter, the data will be added in a simple arithmetic operation of $A + B$. Use this mode when trying to obtain a summed waveform. For example, if recording A has a value of 10 uV at a particular data point, and recording B has a value of 15 uV, the resulting addition will have a value of 25 uV; regardless of the number of sweeps in A or B.

Adding

To add two or more recordings, select the recordings by clicking on them while holding the **[CTRL]** key on the keyboard, then press the **[+]** key or use the main menu to select **[PROCESS > ADD SELECTED RECORDINGS]**.

If you would like to add all recordings on the current page, from the main menu choose **[PROCESS > ADD > ALL ON PAGE]**. Note there are two additional options for adding waveforms with their pre-marked peak Vs aligned.

Subtracting

To subtract two recordings, choose the recording you want to subtract, your subtrahend, then while

holding the **[CTRL]** key on the keyboard choose the recording you want to subtract from, the minuend. Then choose **[PROCESS > SUBTRACT TWO SELECTED RECORDINGS]** or use the **[-]** key on your keyboard.

Note that this will subtract the secondary recording (with the grey filled handle) from the primary recording (with the black filled handle); to reverse the order simply select the secondary again to make it's handle black, defining it as the new minuend.

The Resulting Waveform

Once you perform an addition or subtraction, a new waveform will appear on the screen. This new waveform will have a thicker plot line to indicate that it is a result. The Recording Information panel will show the operands in the comment section under the General tab.

If you intend to keep the resulting waveform, you must save it into a new recording file. To do this click on **[RECORDINGS > SAVE ACTIVE RECORDING]**. Saving a report using **[REPORT > SAVE REPORT]** will also save the result into a recording file.

Adding from Multiple Patient

Some research studies may require the addition of data coming from multiple patients. The recommended method for is to use the data extraction utility or to export the waveforms to ASCII then use a third party tool or software to perform the addition. However it is possible to do it in SmartEP directly. Backing up your IHSData folder is recommended before starting a data merge operation.

To do this:

1. Create a new patient folder by clicking on **[PATIENT > NEW]** and name it something appropriate like "Grand Average"
2. From the patient menu, click on the **[CLEAR DATA ON NEW PATIENT]** option so it becomes unchecked.
3. Load the first patient containing data you wish to include, then load the recording you wish to include in the average.
4. Continue loading patients and their data until you have all the data you require.
5. Reload the special patient folder you created in step 1.
6. Reactivate **[CLEAR DATA ON NEW PATIENT]**.
7. Perform the addition or subtraction operation as necessary.
8. Save the new recording by selecting it, then using the **[RECORDING > SAVE ACTIVE RECORDING]** option in the main menu.



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