# EEGpal: **Epoching module**

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The module 'Epoching' has three purposes:

1. As its name suggests, it allows you to create epochs from a pre-processed EEG file. In other words, it allows the signal to be divided into several segments of equal length. The origin of the segment can be a trigger/marker or the whole file.
2. The module also allows artefact rejection. In the 'ARTEFACT REJECTION' tab, you can specify a rejection criterion and the epochs that don't respect it will be suppressed/ignored.
3. Finally, the module allows you to average all the clean epochs to create an Event Related File (ERP), which is the most common type of analysis in EEG.

Pannel A: EPOCHS

1. In EEGPal, we made the distinction between triggers (tag inside of the EEG file) and marker (tag recorded in a separate .mrk file). Here, you can choose to work with triggers (*in file* button), with markers (*.mrk* button) or with both (the default option). EEGpal will list all these different tags in the section *Events found in input files*.
2. You have the possibility to shift the position of the event if you want (for example to take account of a systematic timing error between the events and the stimulation due to technical reasons like display delays measure with a photodiode sensor). You can specify a negative delay to move before the event or positive for after. Enter the delay either in millisecond or TF.
3. Specify the Events that you want to study (by using comma or space to separate them). Value must be listed in the section *Events found in input files*.
4. Specify the duration of the Epoch. It is important to note that the timing is relative to the event. It means that if you want to include a period of time before the event, you must enter a negative value for the onset (in this example, the Epoch length will be 100 ms before the event and 500 ms after it). You can enter the onset and offset either in ms or TF. For the offset, use the button *EoF* (=end of file) if you want that your epochs last until the end of the file
5. The *Split* *into sub-epochs* button permit to create sub-epochs. This option is typically use when you want to divide all your EEG files into epochs without taking account of the events (used typically in frequencying analysis which required to cut the signal into small equal portions. See the FAQ for more details.  
   Note: The field Number of *Sub-epochs* as well as the *Epoch offset value* with **EoF** activated, give values regarding the first file of the list. However, if you have several files with unequal length, these values will be adapted to fit for each file.
6. The *baseline correction* consists to subtract the mean amplitude of a specified period of the Epoch (the baseline) to the whole Epoch (see FAQ for more comprehensive explanation of its use). You can choose between several presents:
   1. None: No baseline correction applied
   2. Whole epoch: Compute the mean amplitude on the whole epochs as baseline
   3. Pre-trigger period: Compute the mean amplitude before the event as baseline
   4. Custom selection: specify yourself the period of the epoch to but considered as baseline (Warning: this period must be inside of the interval specified in the Epoch in **4**).
7. The same as the point **6** but only for the Auxiliary channels if you have specified some in the **Electrode Setting** option from the main EEGpal windows.
8. This is the saving option related to the epoch computation with :
   1. *One file per epoch*: Record a separate file for each clean epochs
   2. *Merge epochs into one file*: Record one file with concatenation of all clean epochs
   3. *Concatenare according to subject*: Concatenate all the clean epochs per participant

Note: ‘Clean epoch’ means epochs which survive to the *artefact rejection*

Pannel B: ARTEFACT REJECTION

1. There is three possible ways to detect bad signal inside of an epoch:
   1. *Max absolute threshold*: Define a maximal threshold amplitude. If this amplitude is reach by one or more electrode(s) during one or more TF, the epoch will be discarded.
   2. *Max step threshold*: Permit to detect jump of amplitude in the signal. If the amplitude difference between two time point reaches the specified threshold, the epoch will be discarded.
   3. *Max range threshold*: If the difference between the highest and lowest amplitude in the epoch reaches the specified threshold, the epoch will be discarded.

In output, a Epoching\_Summary.xlsx file will be generated with the details about how many epochs has been reject by each criterium. More details about use in the FAQ.

1. Same as 9 but only for the Auxiliary channels if you have specified some in the **Electrode Setting** option from the main EEGpal windows.
2. Need to be add
3. Functionality not available for now. Need to be updated. You can decide if you want to exclude one or several channels from the artefact rejection test. Untick the channel that you don’t want to test.
4. Functionality not available for now. Need to be updated. Automatically ignore the electrode marked as bad by eeglab clean\_rawdata toolbox.
5. **Facultative:** AR evaluation is a tool which permit to perform the tests of artefact rejection by only record the Epoching\_Summary.xlsx and will modify the marker of the input file to indicate if the epochs were accepted or rejected. A safety copy of the marker file before modification is recorded at the same localization as the input files.   
   WARNING: It is important to understand that it is only an additional tool which is not mandatory to perform a standard epoching/averaging analysis.

FAQ

**What the output looks like?**

**How can I use Epoching module for my frequencying analysis or rejection time periods with a bad signal?**

In frequencying analysis, it required to cut the signal into small equal portions (epochs) and to remove those with a bad signal. In this particular case, leave empty the field *events* (**3**), select the whole file with an *Epoch onset*=0, *Epoch offset* = EoF (**4**) and activate the option *Split* *into sub-epochs* and choose the length of these sub-epochs (**5**)(2000ms for example). In this case, all the eeg file will be cut in Epochs of 2000ms and every of them will be tested for the *Artefact Rejection*(**B**)*.* To record a new file with all the clean Epochs concatenate, selection the option *Merge epochs into one file* (**8**). Then you will use this file in the Frequencying module by using an Epochs length of the same size as the sub-epochs duration you have specified in this module.

**When should I use baseline correction?**

As explain in the point, the baseline correction consists to subtract the mean amplitude of a specified period of the Epoch (the baseline) to the whole Epoch.   
The most commonly use option in the use the whole epoch as baseline to compensate the differences of general amplitude along the EEG recording (mainly due to signal drift). It permits to have a more comparable amplitude between the epochs (correction by this relative baseline).   
Some of authors prefer to not apply any baseline to avoid to losing significant difference between condition (it is true that baseline correction make the result more trustful but also more conservative).   
In some case, people use a pre-trigger baseline. It permits to ensure that the amplitude on the event is 0. However, this is valid only if you make the hypothesis that there is no effect of anticipation or any signal related to the event before it which is rarely the case. It is why this option is commonly not used.

**Which method of artefact rejection should I use?**

The three methods proposed by EEGpal has been use in the literature. The *Max absolute threshold* is the default method use by Cartool. In our laboratory (using a Biosemi system), we usually use a threshold between 80 to 100 µV. Practically, the *Max range* perform a similar job.   
There is no gold rule about which one to use. Look at the summary file generate as output to see how many epoch where rejected according to each criteria.