



## **BESA Simulator**

**Create your own evoked and induced data**





**BESA Simulator** can be used for simulating your own evoked and induced data! **BESA Simulator** runs on Windows, Mac OS, and Linux.



Simply scan the above code

**Can YOU localize  
your simulated sources?**

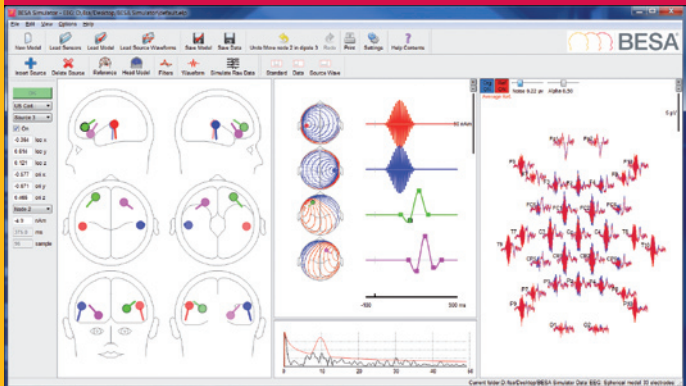
**BESA Simulator** is the perfect tool for simulating evoked and induced brain activity. Place your sources, assign them a time-course and save your data with an electrode layout of your choice.

You can simulate average data or raw data choosing your own real dataset for overlaying the modeled activity. This allows simulating induced data, as well as evoked data.

Use the simulated data to examine your source or coherence analysis techniques. Do you manage to localize the simulated sources?

Use **BESA Simulator** to create your own theories about brain networks underlying your data and see if they hold true in real data.

# Create a Source Model



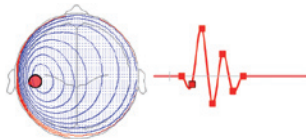
Place sources, assign them a time-course,  
add noise

## Creating average data

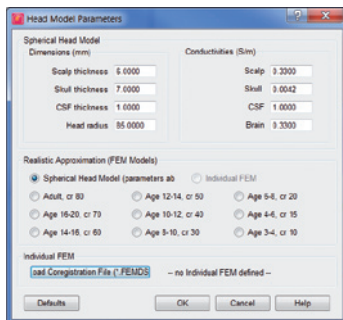
Start **BESA Simulator**. Place **sources** of your choice in the head schemes by **double-clicking** or pressing the **+** button. You can move the sources by grabbing them using the left mouse-key. Change their orientation by grabbing the dipole tails. The mouse pointer will change from hand to a cross.

The middle panel shows the default activity pattern of the sources along with a corresponding map. Note how the maps change when you change the orientation of the sources! The right panel shows the activity recorded by the EEG electrodes if the current sources were active. **The electrode layout can be changed to your own setup by pressing Load Sensors!** It is also possible to use an MEG sensor layout.

**Change the time-course** of a source by **double-clicking** on the 0-line. This will create a new node that can be moved into place as desired. Move the nodes along the 0-line to alter on and offset of the activity.

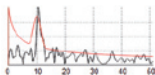



**BESA Simulator** offers a choice of head models. For EEG, it is possible to use a 4-shell ellipsoidal, various standard FEM models or an **individual FEM model** if available.

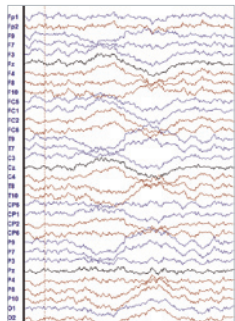
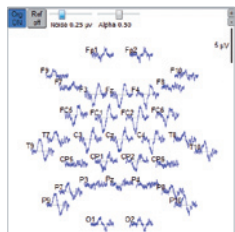




**Add noise** to the data by moving the noise slider. You can alter the amount of alpha activity by moving the according slider. The noise characteristic is displayed in the bottom window of the middle panel.




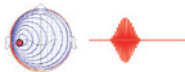
**Save average** data based on the current model by pressing the button **Save Data**. Data will be saved  in ascii vectorized format. Data can now be loaded in any other program and source localization can be performed attempting to reconstruct the modeled sources and their activity pattern.




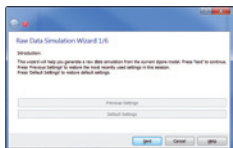
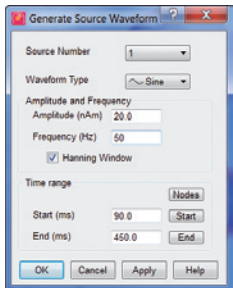
## Creating induced activity in raw data

After creating a source model, you can simulate induced (and of course also evoked) raw data. A wizard will assist you in generating raw data.

We will now simulate induced 50 Hz oscillatory data. Press the waveform button  and make sure the shape of the waveforms in your source model is a sine wave and the frequency is 50 Hz. You may set your desired amplitude and time range of the oscillation. Start and end-time refer to onset and offset after the trigger that will be written to the output dataset in the next steps. Your waveform should now look like this:



Press the button **Simulate Raw Data**  to open the Simulation wizard. Continue with **Next**.



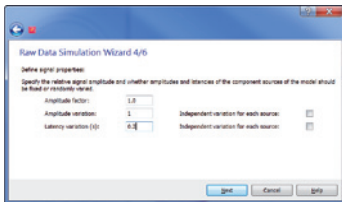
You will first need to specify an input dataset, the model data will be overlaid with. Input data must be in simple binary format (generic file format). Make sure that the electrode layout of your source model matches the electrode layout of the input dataset! Specify an output name and continue with **Next**.

Enter the desired trigger code, the number of triggers that are to be generated, the mean interval between the triggers and an interval variation. **Next**.



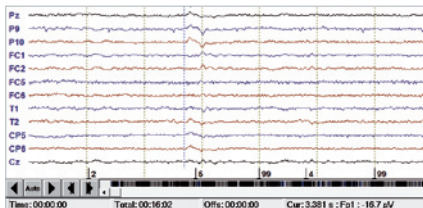
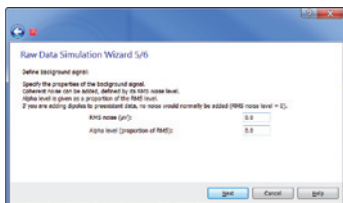
Trigger ID sets the output trigger name that will occur in the raw data and mark the onset of the model activity. Mean interval marks the latency between two triggers and allows the specification of a temporal jitter.

Signal properties allow you to specify an amplitude factor, amplitude variation and latency variation. **Next.**



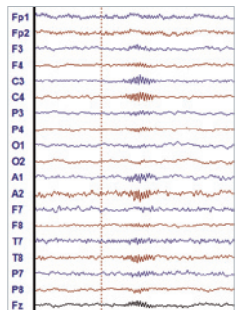
An amplitude factor of 1 means, that the model data will have the same amplitude as the average input data. An amplitude variation of 1 varies the amplitude between 0 and twice the amplitude of the input simulation. Latency variation specifies a value in seconds: the latency relative to the trigger will be varied  $\pm$  this value. Therefore, to model oscillatory induced activity you need to specify an amplitude variation factor and a latency variation factor  $> 0$ .

It is possible to alter the properties of the input EEG signal by adding noise. The noise will be overlaid on the input signal and may contain an alpha proportion of your choice.

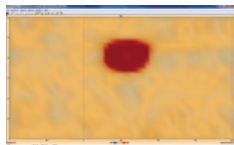


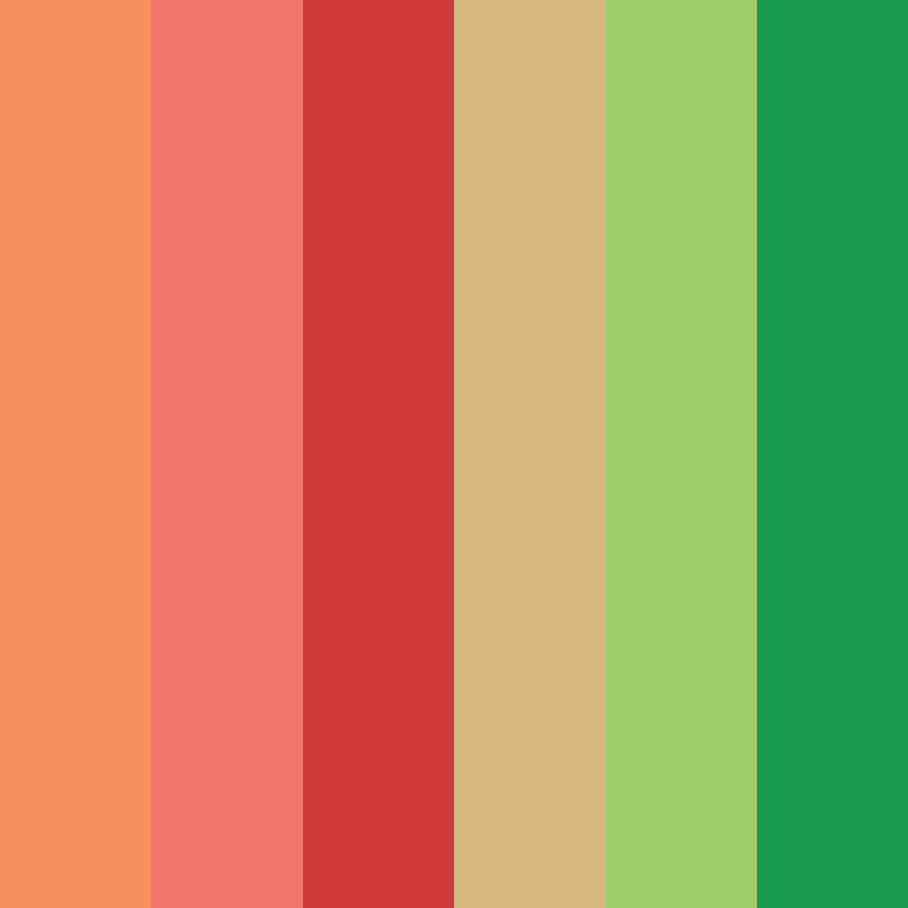
The resulting output dataset will contain triggers of the specified trigger code (here: 99). The modeled induced activity of 50 Hz will occur according to the specified settings (here: amplitude variation=1, temporal jitter after trigger 200 ms) following the trigger.

Averaging around trigger 99 (which of course would not exist in a real dataset) in the output dataset shows the oscillatory 50 Hz signal.



Running time-frequency analysis also clearly reveals the 50 Hz oscillation.





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