BESA Connectivity 2.0 Update History

Version 2.0 May 2023

New features

Themes and user interaction

- The colour theme can be adjusted between *BESA White* and the previous *BESA Standard*.

Time-Frequency Analysis

- BESA Connectivity 2.0 offers a batch processing mode in time-frequency projects that allows loading data sets for multiple subjects simultaneously and processes all those data sets in one project. Up to 10 different conditions are supported. For each condition, it is possible to select several data sets in the Load Data dialog.

- Grand Average views and data exports of multi-subject time-frequency analysis are available.

- A multi-taper method is introduced to the time-frequency methods. Multitaper analysis uses several tapers to decompose the signal into its frequencies. Here, Slepian Sequences are used to construct the tapers, which are then used in a time-frequency decomposition of the signal. Multitapering combines the properties of the different tapers to control the leakage and smooth the signal in the frequency domain. The multitaper transformation uses a sliding time window with a length that decreases with increasing frequency.

- Data export:

  - Export project results: Averaged time-frequency results of all decompositions and data sets are exported. They can directly be read in to BESA Statistics.

  - Averaged TF data: Selected display type options (temporal-spectral evolution (TSE) or absolute (ABS) values for amplitude or power) are considered during export.

Connectivity Analysis

- Batch processing: When loading a time-frequency project containing multiple conditions with multiple data files, connectivity analysis for all those data files can be computed within one project.

- Grand Average views and data exports of multi-subject connectivity analysis are available.

- New connectivity methods:

  - Phase lag index (PLI) (Stam et al. 2007)

  - Weighted phase lag index (WPLI) (Vinck et al., 2011)

  - Directed phase lag index (dPLI) (Stam and van Straaten, 2012)

- Circular Graph View: This new visualization mode places the sources (or sensors) on a circle and shows the coupling strength as connections for the selected latency & frequency bin between all combinations of sources. The channels are automatically arranged in four quadrants (left anterior / right anterior / left posterior / right posterior) to facilitate interpretation.

- Simultaneous averaging over time and frequency: when both averaging options are selected the matrix view changes to a visualization of a single tile per connection, thus enabling a connectome view for the selected time-frequency range.

- Freeze-Pane mode for TFC View: Channel labels will remain visible at the left-most column and top-most row of the matrix display even if the visualization is zoomed by the user.

- The 3D visualization takes into account the colors and sizes of the sources specified in the BESA Solution File Format (*.bsa).

- Data export:

  o Export project results: Connectivity results of all selected methods and data sets are exported. They can directly be read in to BESA Statistics.

Bugfixes

Time-Frequency Analysis

- Computation of average for time-frequency decomposition has been corrected. Previously, export of results used time-frequency decomposition of average waveforms. Now, the export uses the average of the time-frequency decompositions. (#1076)

- Information on channel and condition names are considered when exporting averaged time-frequency data. (#799)

Connectivity Analysis

- Sensor-level connectivity can now be shown for the 27-channel CSD montage. (#1052)

- During export of connectivity results based on wavelet decomposition, the wrong frequency range was listed in the header line of the exported file if the lowest frequency was below 4 Hz. This issue is now fixed. (#658)

- A crash of the application was fixed that occurred when selecting the *Show 3D Mode* checkbox for polygraphic data. (#647)

Known issues

The following known issues could not be fixed for this release, and remain in the software:

Time-Frequency Analysis

- For visualization of TSE (amplitude and power), values are not displayed as percentages. To obtain the percentage value, multiply by 100.

Connectivity Analysis

- 3D visualization of sensor data may cause issues on certain PCs, if a montage contains several channels with the same origin (e.g. bipolar channel montages). To avoid the issue, remove channels with identical locations from the montage before exporting data to BESA Connectivity.

- Saving results after connectivity analysis may cause error messages for large data sets. To avoid the issue, reduce the size of the data set, e.g. by using fewer connectivity methods, fewer conditions, or fewer time-frequency methods.