



Data review and processing



Onset of epileptic seizure with 3D whole-head maps and hemispheric comparison of density spectral arrays (DSA)

Data import and export

- Direct readers for most EEG and MEG data file formats
- Import of user-defined file formats using generic reader
- Data import /export to ASCII and binary formats, e.g. MATLAB

Data preprocessing

- Superior digital filtering: high, low, and narrow band pass, notch
- Interpolation from recorded to virtual and source channels
- Automated EOG and EKG artifact detection and correction
- Advanced user defined instantaneous artifact correction
- Pattern detection and averaging by spatiotemporal correlation
- Linear and non-linear correlation between scalp and source channels
- Spectral analysis: FFT, DSA, power and phase mapping

Data review

- Easy and fast review of digital EEG and MEG data files
- Fast paging, tagging, and selected viewing of epochs of interest
- DSA and event displays for quick jump to relevant pages
- Additional selected and virtual artifact channels (EOG etc.)

Source montages and 3D whole-head mapping



Graphical display of a user defined montage combining bipolar EEG and brain source channels

Montage editor

- Graphical editing of user montages for convenient data review
- Virtual montages with standardized electrode locations
- Combined montages of recorded, virtual, and source channels
- Immediate resorting for regional and hemispheric comparison

Source Montages

- Transformation of surface EEG or MEG into brain source activity
- Montages derived from multiple dipole or regional source models
- Standardization for various brain regions or definition by the user
- Additional channels to display PCA components and /or eye artifacts

3D whole-head mapping

- Whole-head spline interpolation for voltage and CSD mapping
- 3D or 2D view of maps, sensors, and head surface points
- Mapping of FFT power, amplitude, and phase
- MEG maps of flux and planar gradients at the scalp surface
- Time series of maps with easy selection of viewpoint, number of maps, and epoch of interest

ERP analysis and averaging



Top data view of two averaged conditions in a P3 paradigm: 3D map and automated output of peak latency and amplitude

Handling of events and conditons

- Scripted paradigms for fast definition of triggers, conditions, epochs, filter settings etc.
- Import, export, and editing of event lists, triggers, and paradigms
- Design of complex conditions by logical expressions
- Creation of triggers from recorded signals, e.g. rectified EMG

Batch scripts for automated processing

- Fast and automated analysis of group studies using batch scripts
- Script functions for paradigm import
- Automated artifact scan with 2D graphical rejection tool
- Batch guided averaging within and across subjects
- User-defined combination of conditions (e.g. difference, average)
- Automated ERP peak detection and latency/amplitude output
- Spatial and temporal data interpolation

ERP displays and tools

- Topographic display and 3D whole-head mapping of averaged waveforms
- User definable layout with postscript export
- Overplot of multiple conditions
- Event-related (de)synchronisation: Display of ERD / ERS waveforms

Source analysis and source imaging



Discrete multiple source analysis and individual minimum norm image of an averaged epileptic spike generated around a frontal brain lesion

Source localization

- Highly interactive graphical user interface for fast hypothesis testing
- Spatio-temporal multiple dipole and regional source modeling
- Automated source fitting: RAP-MUSIC, Genetic algorithm
- Minimum norm images based on the individual brain surface
- Realistic standardized FEM and multi-shell ellipsoidal head models
- PCA analysis with generation of spatial source components

Source imaging

- 3D imaging of oscillatory activity using the multiple source beamformer (MSBF)
- Source projection onto standardized or individual MRI
- 3D mapping of source activity onto individual scalp and cortical surface
- Movie of maps and dipoles using source waveforms
- Tomographic source sensitivity display
- Automated multiple source probe scans (MSPS) for model validation

Source import and export

- Direct transfer of source models between subjects and conditions
- Export of source models and source waveforms in ASCII
- Creation of source montages
- Coordinate systems: Talairach/Head/ Device/Unit Sphere

Integration with MRI and fMRI



3D beamformer image of motor-related oscillatory brain activity superimposed on the individual ana-tomical MRI

BrainVoyager™

- Direct and easy interactive user interface of BESA[®] with the BrainVoyager[™] program
- Analysis of individual MRI and fMRI data in BrainVoyager™
- Separate license required for the BrainVoyager™ (BV) program

MRI and fMRI analysis (BV)

- Visualization and processing of individual MRI and fMRI
- Automated rendering of scalp and cortical surfaces
- Expansion and flattening of the cortical surface

Coregistration of EEG & MEG with MRI (BESA[®] + BV)

- Coregistration of coordinate systems by fiducials and/or surface points
- Direct import and display of individual anatomical MRI in BESA® (volume data, head surface, brain surface)
- Projection of BESA[®] source models into the individual MRI in BESA[®]
- Direct imaging of 3D source images in the individual MRI
- Minimum norm current image based on individual gray/white matter boundary
- Seeding of sources into BESA[®] from anatomical 2D or 3D MR images or from fMRI BOLD clusters in BV via interactive link
- Overlapped display of fMRI and EEG/MEG sources in BV

Source coherence and time-frequency display



Time-frequency display of source coherence between nine brain regions of a user-defined source montage in an ERN experiment

Time-frequency analysis

- Temporal-spectral information optimized by complex demodulation
- Time-frequency diagrams based on surface or source channels
- Display of absolute power, spectral amplitude and temporal spectral evolution (TSE) in percent
- Variable setting of time-frequency resolution
- Separation of evoked and induced activity
- Direct comparison of two conditions
- 3D Imaging of oscillatory activity using the new BESA® Multiple Source Beamformer (MSBF)

Source coherence

- Oscillatory coupling between brain regions analyzed directly in brain source space using source montages
- Calculation of cross spectral density matrices between any combination of source (and/or surface) channels
- Event-related coherence displayed in time-frequency space
- Display of magnitude squared coherence and phase coherence
- Computation and display of phase delay and latency difference between channels

Statistical analysis

- Statistical probability maps based on resampling of the single trial data
- Statistics available for all time-frequency displays (absolute amplitude, TSE, coherence, comparison of conditions)
- Export of displayed data for offline statistics across subjects (e.g. in MATLAB)

BESA® 5.1 – choose the best analysis tool for your EEG and MEG data

BESA[®] (Brain Electrical Source Analysis) is the most widely used software for source analysis and dipole localization in EEG and MEG research. BESA[®] has been developed on the basis of 20 years experience in human brain research by Michael Scherg, University of Heidelberg, and Patrick Berg, University of Konstanz. BESA[®] is a highly versatile and user-friendly Windows[®] program with optimized tools and scripts to preprocess raw or averaged data for source analysis. All important aspects of source analysis are displayed in one window for immediate selection of a wide range of tools. BESA[®] provides a variety of source analysis algorithms, a standardized realistic head model (FEM), and allows for fast and easy hypothesis testing and integration with MRI and fMRI.

BESA[®] source coherence – analyzing oscillatory coupling between brain regions

BESA® transforms the surface signals into brain activity using source montages derived from multiple source models. This allows to display ongoing EEG, single epochs, and averages with much higher spatial resolution. The BESA® Source Coherence Module provides an extremely fast and user-friendly implementation of time-frequency analysis based on complex demodulation. Users can create event-related time-frequency displays of power, amplitude, or temporal spectral evolution and coherence for the current montage using brain sources or surface channels. Induced and evoked activities can be separated. Source coherence analysis reveals the functional connectivity between brain regions by reducing the volume conduction effects seen in surface coherence.

BESA® 5.1 – more than just dipole source localization

BESA® covers the whole range of signal processing and analysis from the acquired raw data to dynamic source images:

- ⊖ Data review and processing
- ⊖ ERP analysis and averaging
- Source montages and 3D whole-head mapping
- Source localization and source imaging
- Source coherence and time-frequency analysis
- Ortical mapping and visualization in 3D/2D MRI
- ← Individual MRI and fMRI integration with BrainVoyager™

System requirements

- ← Pentium 800 MHz or better, 512 MB RAM
- ← Windows[®] XP, 2000 or NT4.0
- ← Graphics card supporting OpenGL 1.1 with 16 MB RAM or more

Information

BESA® is licensed for research use only, not for use in diagnostic procedures. For more information, tutorials, and demonstrations, please visit our homepage:

www.besa.de