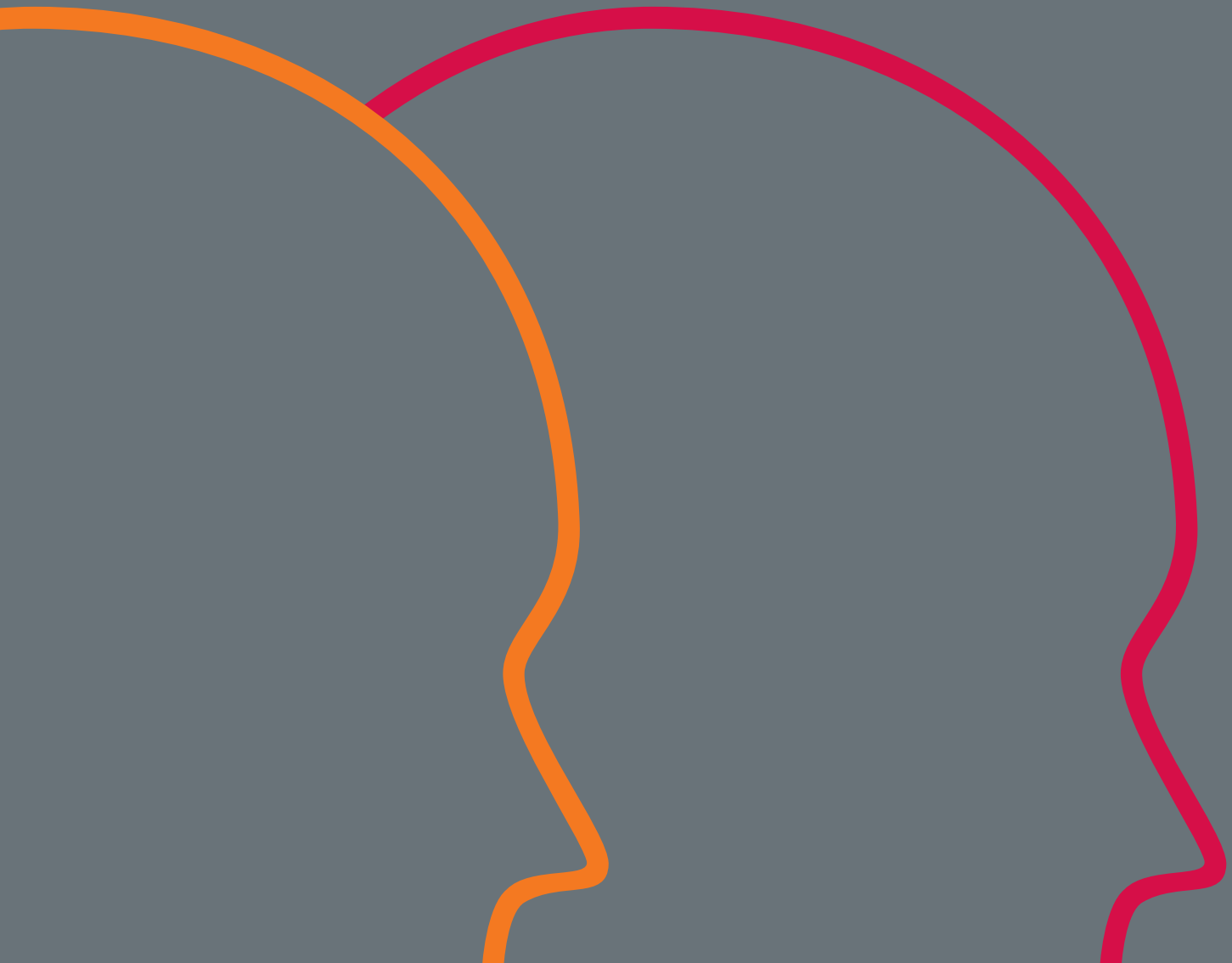
BESA®

BESA Research

CE–certified software package for comprehensive, fast, and user-friendly analysis of EEG and MEG



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

BESA® Research is the most widely used software for source analysis in EEG and MEG research. It has been developed on the basis of over 20 years' experience in human brain research. BESA® Research offers all tools for effective preprocessing of raw data including artifact correction (ICA and PCA) / rejection and spline interpolation of bad channels. Triggers can be easily used and combined to complex conditions for averaging. BESA® Research offers a wide range of source analysis techniques (discrete, distributed, multiple source beamforming). Standard and individual realistic head models (FEM) can be used in combination with BESA® MRI. Time-frequency analysis is available for analyzing evoked and induced activity. Coherence between sensors and sources can be calculated using source montages or direct imaging of coherent sources (DICS). Data analysis can be done in batch mode and all processing stages allow sending data to MATLAB® with a direct interface.

NEW

BESA® Research 6.0 – new features

ICA: Data can now be decomposed into independent components. It is possible to use individual (and combinations of) ICA components for artifact correction or as spatial components in source analysis. It is also possible to create ICA-reconstructed data for source analysis of specific ICA components only.

DICS: With Dynamic Imaging of Coherent Sources it is possible to calculate coherence between any pair of locations in the brain. DICS also allows calculating coherence between an external channel and a brain source.

Realistic Head modeling with FEM: In combination with BESA® MRI it is now possible to generate individual head models using the finite element method. BESA® MRI FEM models contain 4 compartments (skin, skull, CSF, brain), thus gaining critical precision in comparison with BEM models. The individually created FEM models are available in BESA® Research through a direct interface between BESA® MRI and BESA® Research.

BESA® Research 6.0 – comprehensive analysis of EEG / MEG data

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

- Data review and processing
- ICA and PCA decomposition
- Classic ERP / ERF analysis and averaging
- Source montages and 3D whole-head mapping
- Source localization and source imaging including beamforming
- Standard and realistic individual head models (FEM) with BESA® MRI
- Source coherence including DICS and time-frequency analysis
- Individual MRI integration with BESA® MRI and fMRI integration with BrainVoyager™

System Requirements

- Windows® 7, Vista, XP or 2000
- Pentium 800 MHz or better, RAM: minimum 512 MB (XP & 2000) / 1GB (Vista / Windows® 7); recommended: 2 GB
- Graphics card supporting OpenGL 1.1 with 16 MB RAM or more

Information

BESA® Research 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

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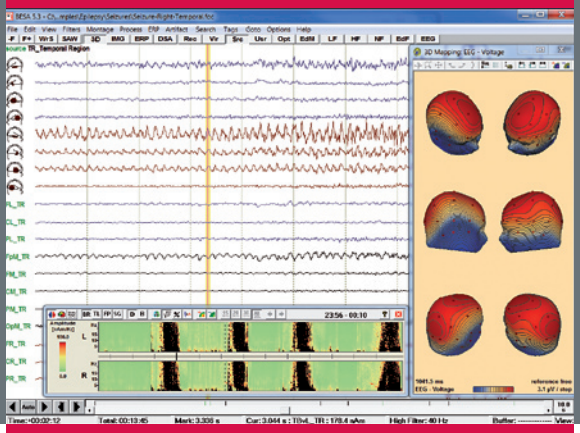
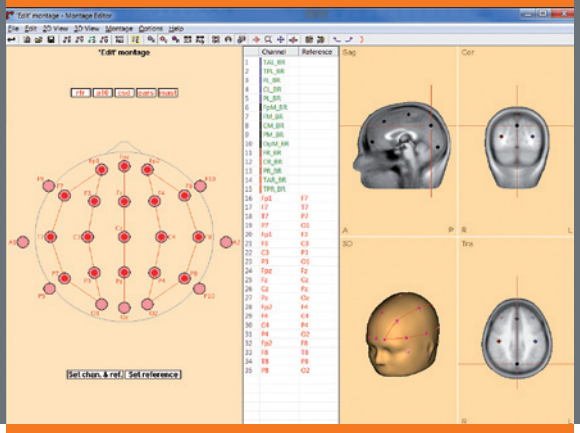
Data review and processing



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

Source montages and 3D whole-head mapping



Graphical display of a user defined montage combining bipolar EEG and brain source channels in 2D and 3D views

Data import and export

- Direct readers for most EEG and MEG data file formats
- Import of user-defined file formats
- Data import / export to ASCII and binary files
- MATLAB® interface for direct transfer of analysis results to MATLAB®

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 epochs
- Additional selected and virtual artifact channels (EOG etc.)

Data preprocessing

- Superior digital filtering
- Interpolation from recorded to virtual and source channels
- Pattern detection and averaging by spatio-temporal correlation
- Linear and non-linear correlation between scalp and source channels
- Spectral analysis: FFT, DSA, power and phase mapping

Artifact Correction and Rejection

- Automatic EOG and EKG artifact correction and correction

NEW - Advanced user-defined instantaneous artifact correction with PCA and ICA

- Graphic artifact rejection using amplitude, gradient and low signal criteria

Montage editor

- Virtual montages with user-defined or standardized electrode locations
- Computation of arbitrary arithmetic combinations of channels
- Remontaging to arbitrary channel averages (e.g. ears, mastoids, user-defined)
- Data export in the current montage

ICA and Source montages

NEW - Decomposition of EEG / MEG data into ICA components

NEW - ICA components displayed as waveforms and topographic maps

NEW - ICA components available for artifact correction and as spatial components in source analysis

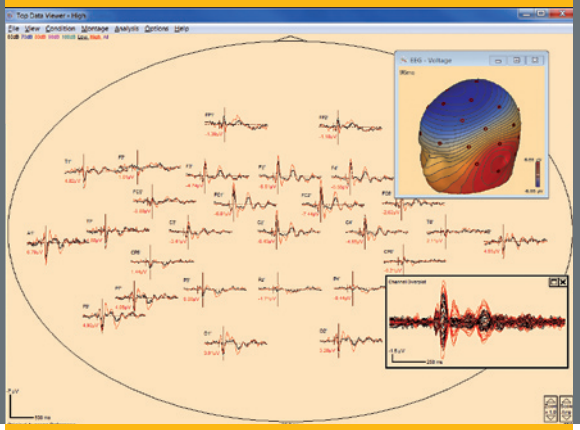
NEW - ICA reconstructed data can be used for source analysis of specific ICA components only

- Transformation of surface EEG or MEG into source space using pre-defined or user created source montages
- Source montages derived from multiple dipole or regional source models

3D whole-head mapping

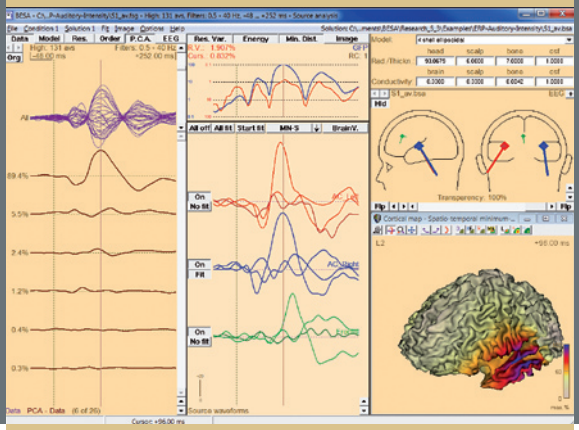
- Whole-head spline interpolation for voltage and CSD mapping
- 3D or 2D view of maps, sensors, and head surface points
- Mapping of FFT power, amplitude, and phase
- MEG maps of flux and planar gradients at the scalp surface
- Time series of maps with easy selection of viewpoint, number of maps, and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

ERP analysis and averaging



Top data view of two averaged conditions in a P3 paradigm: 3D whole-head map, channel overplot, and additional channel display

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

Handling of events and conditions

- 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

Averaging

- Arithmetic combination of conditions (e.g. difference, average) within and across subjects
- Averaging across datasets with different sampling rates and channel layouts using temporal and spatial interpolation
- Weighted averages
- Plus-Minus averages, odd / even averages first half / second half averages

ERP displays and tools

- Topographic display of data in pre-defined and user-defined montages
- User definable layout with vector file export
- Overplot of multiple conditions and channels

Standard and individual realistic head models

- Realistic standardized FEM and multi-shell ellipsoidal head models

NEW - Individual realistic FEM models in combination with BESA® MRI (seperate license required)

Discrete source localization

- Highly interactive graphical user interface for fast hypothesis testing
- Spatio-temporal multiple dipole and regional source modeling
- Image-weighted source fitting
- Automated multiple source probe scan, (MSPS) for model validation
- Automated source fitting: RAP-MUSIC, genetic algorithm

NEW - Adding spatial components from PCA or ICA analysis source components

NEW - Source localization of ICA reconstructed data

3D source imaging

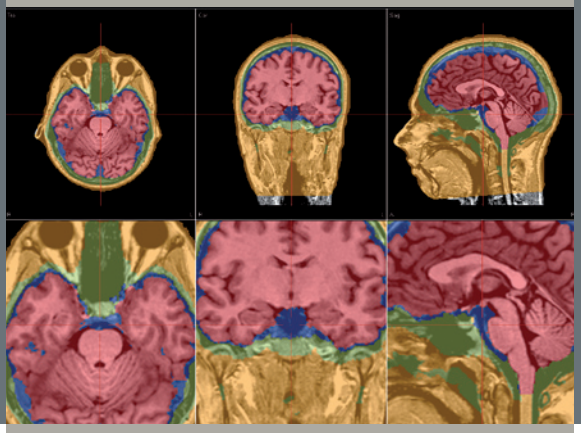
- 3D imaging of time-frequency activity using a multiple source or single source beamformer
- Distributed source imaging: CLARA, LORETA, sLORETA, swLORETA, LAURA, sSLOFO, minimum norm
- Iterative, focusing 3D imaging by CLARA (Classical LORETA Analysis Recursively Applied)
- User-defined 3D imaging methods
- Movie of 3D maps, images, and dipoles

Source import and export

NEW - Leadfield export

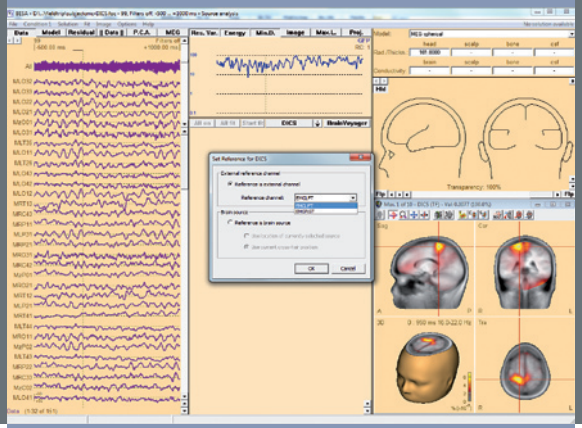
- Direct transfer of source models between subjects and conditions
- Transfer of source models, waveforms, and 3D images to MATLAB®
- Export of source models and source waveforms in ASCII format
- Coordinate systems: Talairach / Head / Device / Unit Sphere

Using individual anatomy



After coregistration and FEM model generation in BESA® MRI the individual anatomy can be used for source reconstruction

Source coherence (with DICS)



Coherence can be calculated between any pair of locations in the brain or between an external channel and a brain source

Time-frequency analysis

- Temporal-spectral information optimized by complex demodulation / Gabor transformation
- Time-frequency diagrams based on surface or source channels
- Display of absolute power, spectral amplitude and temporal spectral evolution (TSE) in percent
- Visualization of inter-trial phase locking
- Variable setting of time-frequency resolution
- Separation of evoked and induced activity
- Direct comparison of two conditions
- Determining statistically significant time-frequency regions within subject with bootstrapping

Source coherence

NEW

- Dynamic Imaging of Coherence Source (DICS): coherence between any two locations in the brain or between an external channel and a brain source
- 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

Batch scripts for automated processing

- Fast and automated analysis of group studies using batch scripts
- Batches for MATLAB® function calls and data transfer
- Automated ERP peak detection and latency / amplitude output
- Batch scripts for time-frequency analysis and 3D imaging
- Automated data import and export

Coregistration with individual MRI

- Coregistration of coordinate systems by fiducials and surface points in combination with BESA® MRI (seperate license required)
- Direct import and display of individual anatomical MRI in BESA® Research (volume data, head surface, brain surface)
- Projection of source models into the individual MRI in BESA® Research
- Minimum norm current image based on individual gray / white matter boundary
- Seeding of sources into BESA® Research from anatomical 2D or 3D MR images
- Seeding sources in BESA® Research from fMRI BOLD clusters in BrainVoyager™ via interactive link

Statistical analysis

- Cross-subject statistical analysis of ERP / ERF data, source waveforms, images, time-frequency / coherence results with BESA® Statistics (seperate license required)
- Statistical Method: Cluster Permutation testing all results are corrected for multiple comparisons

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