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EMSE® Suite Version 5.1

Feature Summary

EMSE® Suite is a set of software tools for EMEG (ElectroMagnetic EncephaloGraphy) analysis and multimodal integration, including source estimation. It consists of six modules, which may be bought separately or as application-specific bundles. This document lists many of the key features of the currently available software, version 5.1, Beta 4, indicating which modules are required for the specified function. Additional information, including a free, full featured, evaluation copy of the software, may be found at www.sourcesignal.com.

1. Data input/output

EMSE® does not have an EEG data acquisition module. The software is capable of reading data from a variety of EEG, MEG, and MRI vendors. EMSE® Locator module may be used with Polhemus Isotrak, Fastrak, or Patriot to digitize 3D electrode locations.

1.1. EMEG vendors and formats supported§

	Required module(s) [R=Read, W=Write]					
Feature	*Data Editor*	*Source Estimator*	*MR Viewer*	*Image Processor*	*Visualizer*	*Locator*
4D Neuroimaging	R					
ASCII/binary raw	R,W					
Biosemi	R					
Brain Vision Analyzer	R					
Cogniscan (Sensorium) (ASCII export)	R					
CTF	R					
Dataq	R					
ebNeuro	R					
EGI (Netstation)	R					
EMSE®	R,W					
ERPss	R					
European data format (.edf)	R					
InstEP	R					
Micromed	R					
Miraclink (MCG)	R					
Neuroscan	R					

§ If we don't support a commercial format, we can write an interface (at no charge) if suitable documentation is available from the vendor

Nexstim	R					
Nihon Kohden (ASCII export)	R					
NTR	R					
Tristan	R					

1.2. MRI vendors and formats supported§

	Required module(s)) [R=Read, W=Write]					
Feature	*Data Editor*	*Source Estimator*	*MR Viewer*	*Image Processor*	*Visualizer*	*Locator*
Analyze (.hdr, .img)			R,W			
DICOM			R			
EMSE® .vmi			R,W			
GE Signa			R			
Siemens			R			
Raw binary			R			
MINC			R,W			

1.3. Electrode digitization

	Required module(s)					
Feature	*Data Editor*	*Source Estimator*	*MR Viewer*	*Image Processor*	*Visualizer*	*Locator*
Polhemus (IsoTrak, Fastrak, Patriot)						✓
Voice prompt for electrode digitization						✓

1.4. Other file types

		Required module(s)) [R=Read, W=Write]					
Feature		*Data Editor*	*Source Estimator*	*MR Viewer*	*Image Processor*	*Visualizer*	*Locator*
Electrode							
	4D Neuroimaging	R		R			
	BESA .sfp	R					R,W
	CTF	R		R			
	Curry .res						R,W
	EMSE® .elp	R,W		R,W			R,W
	Nexstim	R		R			R
	Neuroscan (.3dd, ASCII export)	R					
Wireframe							
	EMSE	R,W		R,W			
	Freesurfer			R			
Visualization							

	.tif					W	
	.vrml					W	

2. Data Conditioning

2.1. EMEG

Feature	*Required module(s)*					
	Data Editor	*Source Estimator*	*MR Viewer*	*Image Processor*	*Visualizer*	*Locator*
Averaging (ERP)	✓					
Baseline correction	✓					
Filter (IIR, zero phase shift)	✓					
Polynomial detrend	✓					
Rectifier	✓					
Spatial prewhitening	✓					
Laplacian	✓					
Common average	✓					
Arbitrary reference montage	✓					
Ocular artifact correction	✓					
Spatial interpolation	✓					
PCA	✓					
ICA	✓					
FFT	✓					
Time-frequency (wavelet)	✓					
Power spectrum (psd)	✓					
Scripting (Wintask)	✓					

2.2. MRI

Feature	*Required module(s)*					
	Data Editor	*Source Estimator*	*MR Viewer*	*Image Processor*	*Visualizer*	*Locator*
Filters and image processing						
Image arithmetic			✓	✓		
Bias field correction			✓	✓		
High/low/median/total			✓	✓		
Convolution filters (Gaussian, Laplacian, other smoothing and sharpening)			✓	✓		
Edge detection			✓	✓		
Sigma filtering			✓	✓		
Tissue parcellation, segmentation						
Brain extraction tool			✓	✓		

	Visual editing			✓	✓		
	Region grow			✓	✓		
	Tissue segmentation wizard			✓	✓		
	Mesh generation wizard (2D, 3D)			✓	✓		
Other							
	Volumetric reconstruction			✓			
	Scripting (Wintask)			✓			

2.3. Multimodal

	Required module(s)					
Feature	*Data Editor*	*Source Estimator*	*MR Viewer*	*Image Processor*	*Visualizer*	*Locator*
EMEG/MRI coregistration			✓			

3. Data Exploration

3.1. EMEG

	Required module(s)					
Feature	*Data Editor*	*Source Estimator*	*MR Viewer*	*Image Processor*	*Visualizer*	*Locator*
Interactive time series display	✓					
Event and interval marking	✓					
Event review mode (accept/reject trials)	✓					
Time-frequency (wavelet) transform	✓					
Spatial Component Analysis (PCA/ICA)	✓					
FFT/PSD	✓					
Topographic mapping (2D/3D/4D)	✓				✓ (3D/4D)	

3.2. MRI

	Required module(s)					
Feature	*Data Editor*	*Source Estimator*	*MR Viewer*	*Image Processor*	*Visualizer*	*Locator*
2D slice viewer (3 orthogonal views)			✓			
3D surface view			✓		✓	
3D cursor			✓		✓	

3.3. Multimodal

Feature	Required module(s)					
	Data Editor	*Source Estimator*	*MR Viewer*	*Image Processor*	*Visualizer*	*Locator*
Overlay source estimation data on MRI	✓	✓	✓			
sMRI/fMRI overlay			✓			

4. Model building – Source Estimation

4.1. EMEG source estimation without MRI

Feature	Required module(s)					
	Data Editor	*Source Estimator*	*MR Viewer*	*Image Processor*	*Visualizer*	*Locator*
Source estimation – time domain	✓	✓				
Source estimation – frequency domain	✓	✓				
Source estimation – time-frequency (wavelet) domain	✓	✓				
Source estimation – spatiotemporal dipole fit	✓	✓				
Source estimation – LORETA	✓	✓				
Source estimation – sLORETA	✓	✓				
Standard head models (3 shell sphere, BEM, FEM[EEG only])	✓	✓				
Standard electrode locations (10/20, extended 10/20)	✓	✓				
Beamformers (adaptive, non-adaptive, linearly constrained minimum variance)	✓	✓				

4.2. MRI tools for source estimation

Feature	Required module(s)					
	Data Editor	*Source Estimator*	*MR Viewer*	*Image Processor*	*Visualizer*	*Locator*
Tissue parcellation			✓	✓		
Surface modeling (triangle mesh)			✓	✓		
Volume modeling (tetrahedral mesh)			✓	✓		

4.3. Multimodal source estimation

Feature	Required module(s)					
	Data Editor	*Source Estimator*	*MR Viewer*	*Image Processor*	*Visualizer*	*Locator*
Realistic subject-specific head model - BEM	✓	✓	✓	✓	✓	
Realistic subject-specific head model – FEM (EEG only)	✓	✓	✓	✓		
Source estimation – cortical surface current density	✓	✓	✓	✓	✓	
Source estimation – inward continuation	✓	✓	✓	✓	✓	
Dipole seeding from fMRI data	✓	✓	✓			
fMRI-weighted CSCD estimation	✓	✓	✓	✓	✓	
Local estimators (for fMRI ROIs)	✓	✓	✓	✓		

5. Hypothesis testing

5.1. Signal space statistics

Feature	Required module(s)					
	Data Editor	*Source Estimator*	*MR Viewer*	*Image Processor*	*Visualizer*	*Locator*
Statistical Nonparametric mapping (SnPM), scalp topography						
Within subject, between conditions	✓					
Within subject, different from zero	✓					
Within group, between conditions	✓					

Multi-subject, between groups	✓					
Multi-subject, between conditions	✓					
Multi-subject, different from zero	✓					
Pairwise comparison	✓					
Multiple comparison correction	✓					

5.2. Source space statistics

	Required module(s)					
Feature	*Data Editor*	*Source Estimator*	*MR Viewer*	*Image Processor*	*Visualizer*	*Locator*
Statistical Nonparametric mapping (SnPM), source data (CSCD, Loreta, inward continuation, beamformers)						
Within subject, between conditions	✓	✓				
Within subject, different from zero	✓	✓				
Within group, between conditions	✓	✓				
Multi-subject, between groups	✓	✓				
Multi-subject, different from zero	✓	✓				
Multi-subject, between conditions	✓	✓				
Pairwise comparison	✓	✓				
Multiple comparison correction	✓	✓				
Dipole confidence intervals	✓	✓				

6. Additional technical specifications

6.1. Platform

Intel or compatible processors under Windows 98/NT/2000/ME/XP. Linux (requires VMWare) or MAC (requires Virtual PC) not supported, but have been used, Linux more reliably than MAC. 1 GHz or faster Pentium 4 or equivalent processor and ≥512 Mbyte RAM recommended (≥1 Gbyte RAM recommended for image processing).

6.2. Documentation

Online HTML help, pdf format, and printed manual available.

6.3. Customer support

Phone, email, and upgrades, one year with initial purchase, subsequent years by subscription. On-site training available. Contact sales@sourcesignal.com for details. 2-day EMSE® workshops are held 1-2 times/year, at various locations around the world. See www.sourcesignal.com for announcements of upcoming workshops.