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EMSE[®] Suite Version 5.0 Feature Summary

EMSE[®] Suite is a set of software tools for MEG (ElectroMagnetic EncephaloGraphy) analysis and multimodal integration, including source estimation. It consists of six modules, which may be bought separately or as a bundle. This document lists many of the key features of the currently available software, version 5.0, 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 or Fastrak to digitize 3D electrode locations.

1.1. MEG vendors and formats supported[§]

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

* currently under development

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

1.2. MRI vendors and formats supported^s

<i>Feature</i>	<i>Required module(s)</i>					
	<i>Data Editor</i>	<i>Source Estimator</i>	<i>MR Viewer</i>	<i>Image Processor</i>	<i>Visualizer</i>	<i>Locator</i>
Analyze (.hdr, .img)			R,W			
DICOM			R			
EMSE[®] .vmi			R,W			
GE Signa			R			
Siemens			R			
Raw binary			R			

1.3. Electrode digitization^s

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

1.4. Other file types

<i>Feature</i>	<i>Required module(s)</i>					
	<i>Data Editor</i>	<i>Source Estimator</i>	<i>MR Viewer</i>	<i>Image Processor</i>	<i>Visualizer</i>	<i>Locator</i>
Electrode						
BESA .sfp	R					R,W
Curry .res						R,W
EMSE[®] .elp	R,W		R,W			R,W
Neuroscan (.3dd, ASCII export)	R					
Wireframe						
Freesurfer			R			
Visualization						
.tif					W	
.vrml					W	

2. Data Conditioning

2.1. EMEG

<i>Feature</i>	<i>Required module(s)</i>					
	<i>Data Editor</i>	<i>Source Estimator</i>	<i>MR Viewer</i>	<i>Image Processor</i>	<i>Visualizer</i>	<i>Locator</i>
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

<i>Feature</i>	<i>Required module(s)</i>					
	<i>Data Editor</i>	<i>Source Estimator</i>	<i>MR Viewer</i>	<i>Image Processor</i>	<i>Visualizer</i>	<i>Locator</i>
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			✓	✓		

* currently under development

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

2.3. Multimodal

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

3. Data Exploration

3.1. EMEG

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

3.2. MRI

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

* currently under development

3.3. **Multimodal**

<i>Feature</i>	<i>Required module(s)</i>					
	<i>Data Editor</i>	<i>Source Estimator</i>	<i>MR Viewer</i>	<i>Image Processor</i>	<i>Visualizer</i>	<i>Locator</i>
Overlay source estimation data on MRI	✓	✓	✓			

4. Model building – Source Estimation

4.1. **MEEG source estimation without MRI**

<i>Feature</i>	<i>Required module(s)</i>					
	<i>Data Editor</i>	<i>Source Estimator</i>	<i>MR Viewer</i>	<i>Image Processor</i>	<i>Visualizer</i>	<i>Locator</i>
Source estimation – time domain	✓	✓				
Source estimation – frequency domain	✓	✓				
Source estimation – time-frequency (wavelet) domain	✓	✓				
Source estimation – spatiotemporal dipole fit	✓	✓				
Source estimation – LORETA	✓	✓				
Standard head models (3 shell sphere, BEM, FEM*)	✓	✓				
Standard electrode locations (10/20, extended 10/20)	✓	✓				

4.2. MRI tools for source estimation

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

4.3. Multimodal source estimation

<i>Feature</i>	<i>Required module(s)</i>					
	<i>Data Editor</i>	<i>Source Estimator</i>	<i>MR Viewer</i>	<i>Image Processor</i>	<i>Visualizer</i>	<i>Locator</i>
Realistic subject-specific head model - BEM	✓	✓	✓	✓	✓	
Realistic subject-specific head model - FEM	✓	✓	✓	✓		
Source estimation – cortical surface current density	✓	✓	✓	✓	✓	
Source estimation – inward continuation	✓	✓	✓	✓	✓	
Dipole seeding from fMRI data	✓	✓	✓			
fMRI-weighted CSCD estimation	✓	✓	✓	✓	✓	

5. Hypothesis testing

5.1. Signal space statistics

<i>Feature</i>	<i>Required module(s)</i>					
	<i>Data Editor</i>	<i>Source Estimator</i>	<i>MR Viewer</i>	<i>Image Processor</i>	<i>Visualizer</i>	<i>Locator</i>
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

<i>Feature</i>	<i>Required module(s)</i>					
	<i>Data Editor</i>	<i>Source Estimator</i>	<i>MR Viewer</i>	<i>Image Processor</i>	<i>Visualizer</i>	<i>Locator</i>
Statistical Nonparametric mapping (SnPM), source data (CSCD, Loreta*, inward continuation)						
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. 800 MHZ or faster Pentium 4 processor and ≥ 512 Mbytes RAM recommended.

* currently under development

6.2. Documentation

Online HTML help 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.