

# EMIGMA V9.x

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EMIGMA V9.x is a powerful interpretation platform for many kinds of non-seismic geophysical data. It has been developed entirely by Eikon Technologies and is supported and regularly augmented by us. It offers versatile solutions for Gravity, Magnetic, Electromagnetic, Induced Polarization, Resistivity, CSAMT and Magnetotelluric geophysical applications as well as new techniques such as CSEM, MTEM, ZTEM and Xhole EM, IP and RIM. The product design seeks a unique style of integrating data processing, simulation, inversion and imaging software as well as many other associated tools.

## EMIGMA V9.x SERIES and PACKAGES

EMIGMA can be packaged in many combinations but essentially EMIGMA V9.x is available in three series, EMIGMA Premium, EMIGMA Professional and Academic **EMIGMA** packages.

**EMIGMA Premium Series** (or our Exploration Series) is primarily intended for practicing geophysicists involved in mineral, oil & gas exploration or groundwater investigations as well as for anyone who utilizes airborne or borehole geophysics. It is available in a complete version applicable to almost all non-seismic data types and covering a whole range of techniques for their processing, simulation, and interpretation or in separate packages. The licenses within this series have no limitations on the number of data points within each data survey contained in the users' databases. A database may contain data from many surveys or many subsets of different surveys.

The EMIGMA data structure is truly a database and not merely an extended spreadsheet like other geophysical products on the market.

The Premium Series is represented by the following packages but not exclusive to the these packages: EMIGMA Complete, EMIGMA for Gravity, EMIGMA for Magnetics, EMIGMA for Airborne FEM, EMIGMA for Airborne FEM+TEM, EMIGMA for FEM, EMIGMA for TEM, EMIGMA for Resistivity/IP, EMIGMA for Potential Fields (EMIGMA for Magnetics and Gravity), EMIGMA EM for Oil and Gas Applications and EMIGMA for MT.

**EMIGMA Professional Series** (Near-Surface) is designed specifically for near-surface applications, such as environmental or geotechnical investigations, where only surface data are involved. The user may purchase a complete version that provides a full range of modeling and analyses functionalities for magnetics, FEM, TEM, resistivity, and gravity as well as separate packages aimed at a certain types of data and thus offering a set of techniques suitable of this type. EMIGMA Professional can be used with ground exploration data too, however the number of data points per survey is confined to 40,000. There is no limitation on the number of data points in any one database.

The Professional Series is represented by the following packages: EMIGMA Near-Surface Complete, EMIGMA Near-Surface Magnetics, EMIGMA Near-Surface IP/Resistivity.

Apart from the packages within these two series, *Eikon Technologies* offers academic licenses of EMIGMA. In essence, ***EMIGMA for Academics*** features the same capabilities as EMIGMA Near-Surface Complete. The main difference, however, is the much lower price for the Academic license, which is *Eikon Technologies* contribution to the educational programs at universities teaching data analyses and modeling skills to the young generations of geophysicists.

## **BASIC FEATURES**

All the licenses of EMIGMA, both in the Premium and Professional Series, feature the following general set of functionalities that can be looked upon as a framework into which data type-specific functionalities are “plugged in”:

- Imports both in the manufacturer's format and as ASCII columnar files
- Database backbone allowing for an easy handling of many datasets and projects and even very large survey datasets
- Data quality control including plotting, editing, filtering, survey location controls, cleaning, trend removal, comparison analyses, and various corrections
- 3D Visualization intended for displaying measured, processed, simulated, or inverted data in 3D space as profiles, vectors, true 3D surfaces, or 3D contoured surfaces, but also used for the interactive building and editing 3D models and inversions
- Gridding based on five interpolation algorithms and incorporating a ProfileViewer tool. The grids may be displayed in a variety of visualization tools, exported and returned to the database as new surveys.
- GridPresentation, MultiGrid, and Contour for viewing the results of interpolations; with Contour allowing for both 2D and 3D data representation
- Plotting providing comparison between measured, simulated and processed data as well as a quick assessment of a single data set
- 3D Modeling allowing for unlimited prism, plate and polyhedra targets, complex topography, multiple body interactions and providing fast and accurate 3D simulations, with a batch mode tool fully integrated into the platform
- 1D and 3D Inversions specific for each license and well as CDT (CDI) tools for some applications.
- Mapping: Through the use of several geotiff formats, maps can be exported for use in such applications as ArcView or Mapinfo. Geotiffs can also be imported to serve as underlay or overlay maps.

## FEATURES BY LICENSE

On top of the above-listed key functionalities, each separate license is completed with its own suite of modeling, inversion, and data analyses algorithms that have entirely been developed by *Eikon Technologies* and thus are easy to support and customize.

***EMIGMA for Gravity*** provides gravity-specific corrections (latitude, free-air, tidal, Eotvos, Bouger, topography); a series of FFT processing tools including derivative calculation, upward/downward continuation and wavelength filtering; 3D modeling enriched with a new, very accurate technique developed specifically for long strike bodies and an ability to calculate up to the 2nd order derivatives of the gravitational acceleration vector; 3D Euler Deconvolution with statistical and Rodin post-processing and, finally, the newly developed 3D gravity inversion algorithm which may include topographic effects if desired along with 2 types for 2D/3D modeling.

***EMIGMA for Magnetics*** provides magnetics-specific corrections (Magnetic Base Station, advanced aeromagnetic compensation); 2D FFT tools for wavelength/wave number filtering, upward/downward continuation, derivative generation, and Reduction-to-the-Pole (3 approaches); an extension to the Magnetic LN algorithm for non-linear magnetic effects as well as the means to allow modeling interactions between multiple bodies 3D Magnetics Inversion based on linear and non-linear inversion tools (Optimization & Direct Matrix Inversion, physical sensitivity functions, iterative non-linear solutions, iterative born approximations, magnetization vector inversions), multi-elevation surveys and the user of either magnetic vector components and TMI derivatives. Also, the 3D topographic effects can be included in the 3D inversion. An advanced 3D Extended Euler Deconvolution with statistical and Rodin post-processing and 2D/3D visualization of Euler solutions is also provided.

***EMIGMA for Airborne FEM*** provides import procedures for virtually any type of dipole-dipole system such as Fugro DIGHEM, RESOLVE, Impulse, Geophex; Hummingbird as well as fixed-wing surveys. Joint Susceptibility/Apparent Resistivity Inversion based on smooth Occam is provided, a non-smooth Marquardt algorithms both model constrained and non-constrained; an Apparent Resistivity tool and Sengpiel Depth-Sections; PEXShow for 2D representation of geoelectric sections and of course a range of 3D modelling. Includes ground data functionality and magnetic data functionality

***EMIGMA for Airborne TEM + FEM*** provides import procedures for HEM data as well as VTEM, Fugro GeoTEM/Megatem/Tempest and AeroTEM. In addition, to the tools provided for HEM described above, stacked 1D inversions are provided capable of processing full airborne surveys, apparent resistivity inversions for each off-time channel, decay rate calculations as well as mapping and display. 3D modelling as well as CDI's are provided. Includes ground data functionality and magnetic data functionality.

***EMIGMA for FEM*** is provided with joint Susceptibility/Apparent Resistivity Inversion based on smooth Occam or non-smooth Marquardt algorithms for resistivity; Apparent Resistivity inversion tools; PEXShow for 2D representation of geoelectric sections, pseudo-section tools, 3D modelling as well as specific tools for integration of data for presentation and inversion.

***EMIGMA for TEM*** is provided with import procedures for various Geonics TEM systems ( e.g. EM37, EM57, EM67), and Geonics EM61/EM63, UTEM3 and UTEM4, Zonge (nanoTEM and ZeroTEM), Sirotem; WTEM, Phoenix TEM, TerraTEM, FastTEM and Crone. Both In-Loop and Out-of-Loop Inversions are provided for either moving or fixed transmitter survey configurations; two-layer and multi-layer inversion based on smooth Occam and non-smooth Marquardt algorithms all techniques may utilize one or many starting models and allow full model constraints. Multi-parameter inversions are now also provided. TEM Pseudo Inversion and CDI. Full 3D modelling including borehole surveys.

***EMIGMA for IP/Resistivity*** is completed with import procedures for time-domain ELREC 6, IPR10/11/12, frequency-domain IP, and resistivity in ASCII format; generic XYZ resistivity import as well as frequency and time domain IP, 3D modeling algorithms allowing for EM effects, off-time or out-of-phase resistivity contrast effects, MIP solutions; Resistivity depth inversions; PEXShow for 2D representation of resistivity inversions; pseudoshow functionality.

***EMIGMA for MT/AMT*** is provided with 3D modeling and Resistivity depth inversions PEXShow for 2D representation of inversions; GBDecomp tool for generating synthetic impedance tensors and noise using decomposition algorithms is also available as add-on. Note, a full range of data and grid displays are allowed but EMIGMA contains no basic MT processing tools. Generally, data is imported as impedances.

***EMIGMA for CSAMT*** is provided with 3D modeling and 1D Resistivity depth inversions, PEXShow for 2D representation of inversions and 3D Visualization of such inversions. Note, a full range of data and grid displays are allowed. E,H or Z data can be imported and utilized. There are no far-field assumptions for CSAMT in EMIGMA but rather the full solution is always processed.

***EMIGMA Electromagnetics for Oil and Gas:*** This new EMIGMA package includes import, modeling and inversion for **MTEM**, **CSEM** 1D/3D modeling (imports are coming) as well as the MT/CSAMT and IP/Resistivity tools. An airborne add-on is also provided which allows for use of all of our airborne EM tools as well as **ZTEM** modeling and imports

## **ADVANTAGES OF EMIGMA**

The major advantage of EMIGMA is that it provides a general framework and intuitive interface for the state-of-the-art suite of non-seismic data interpretation techniques. You can have it “all-in-one” or as separate data type-specific packages; however, no matter what kind of license you choose, you will be fully equipped with all the required tools of data analyses and data presentation, starting with raw data imports through processing and corrections to the most sophisticated modeling, interpretation and data mapping techniques.

No less important is EMIGMA’s flexibility and high responsiveness to the demands of this continuously developing industry. From the very beginning, EMIGMA was conceived to have a huge potential from both the scientific and programming standpoints. Its framework was designed with a provision for new tools and functionalities to be added whenever required. That Eikon Technologies has developed all of the embedded modeling and inversion algorithms adds tremendously to its flexibility and makes it even more competitive among similar software products based on academic algorithms. Improvements and extended developments can easily be made and in fact are continuing on an ongoing basis. Most importantly, if you find a bug, we can find it quickly and get it fixed. Also, professionals not just as mathematicians develop the algorithms but as software developers, the algorithms are tested exhaustively on a range of hardware and all prevalent Windows operating systems. We are fully Vista/W7 compatible and have been since early 2008.