

## **BRIEF OUTLOOK FOR EMIGMA**

One of our considerations for EMIGMA has been the addition of processing and mapping features. Many features have been included in these areas and we will continue to improve the processing features as well as developing faster methods to perform various processing aspects. Also, in the last several years, we have focused on the development of improved inversion techniques for different data types. A few years ago, we returned to our roots to enhance and extend our forward modeling (simulation) algorithms. Additionally, we have completely re-worked our Gravity, Magnetism and Resistivity inversion tools. We continue to improve the accuracy and productivity characteristics of our much-used TDEM inversions and recently have added 3D thin sheet inversions for both time domain and frequency domain data. In recent years, our 3D grounded source inversion for ground voltage and magnetic measurements have been dramatically extended which can be utilized for ground based CSEM as well as the more traditional CSAMT. This year, we have worked extensively on advancing two of our EM forward algorithms to augment their usefulness, accuracy and computational speeds.

One of the issues which required our attention is to extend the ability of EMIGMA to manage not only the geophysical setup of your data allowing for automated modeling and inversion but the inclusion of all the associated data channels that may be crucial for your proper understanding of the inversion and simulation results. To this end, we have developed and continue to further develop our new software package QCTool. QCTool is capable of handling huge amounts of data and performing most basic and extended data processing functionalities. The combination of QCTool with EMIGMA will resolve our ultimate objective. Magnetic, Gravity, Airborne TDEM, CSEM, IP/Resistivity, FDEM, ZTEM, MT and other forms of data may now be imported directly from the .qct format. This will allow for ready imports of quite a variety of relevant data into EMIGMA after having passed them through appropriate quality control and processing in QCTool. We are also working on the direct import of the other associated data channels into EMIGMA and the possibility of their display and analyses in graphical applications. Our latest version, released in 2025 (V11.5), offers many enhancements over EMIGMA V10.0 which was released in the fall of 2022. EMIGMA is now fully compatible with Windows 11 as well as Windows 8.1, 10 and Windows 7 for both the 32-bit and 64-bit versions and still compatible with Vista.

Most EMIGMA licenses now include the latest QCTool. QCTool is available from our websites for a free 7 days of use and its cost is very low compared to our competitors. In the meantime, we will be enhancing the linkages between the two packages to provide you with this " all-in-one " smart and easy-to-use software platform.

Another important consideration for EMIGMA is to increase its capability of handling and processing large datasets whether collected on the ground or in the air. To this end, we have been extending our principal algorithms and approaches to have them work faster and more efficiently. Great progress has already been made with regard to modeling and inversion solutions.

We have a suite of forward simulation algorithms for EM with each algorithm having its strengths and weaknesses. For example the non-linear approximation (LN) is very good at computing the response of weak conductors or highly resistive structures and galvanic responses for structures which are both conductive and magnetic. However, it does not

compute the inductive response well for a highly conducting feature. The Sphere algorithm is highly accurate but is limited in shape while the FSPlate algorithm is limited to being a thin-sheet and not computing the effect of magnetism. At present, the responses of different targets may be combined by a manual process but this is a somewhat limiting in its ease of use. To overcome these issues, we are working to allow the use of multiple algorithms in a single model in direct manner with an ease of use for the modeler.

## **EMIGMA'S PRESENT TECHNIQUES TO BE EXTENDED**

- Airborne 1D&3D TDEM inversions — **now available in an array of configurations**  
*IP effects in TDEM inversions (already available in modeling)*
- Storage of TEM source moments (current and dipole moments) — **available**
- 3D magnetic inversions with vector components and gradients — **available**
- 3D Gravity inversion with gradients and topography included in the inversion grids (**available**)
- 3D Resistivity inversion Surface and Surface to Borehole (**available**)
- CSEM/CSAMT 3D inversion with 3D source for field data (**available**)
- Enhanced FDEM inversions including constrained Marquardt style (**available**)
- CSEM forward modeling and inverse modeling with Zonge and Phoenix native imports (**available**)
- More general multi-array resistivity imports, enhanced IRIS system imports (**available**)
- New TEM imports for such systems as FASTEM, TERRATEM, Phoenix TEM (**available**)
- Extended basic gravity processing (Bouguer, topographic, terrain, isostatic, etc) (**available**)
- Enhanced mapping tools — (**available**)
- Map outputs to GEOTIFF format — available, use of GEOTIFFs with data maps (**available**)
- Inversion models to plan and cross section exports (**available**)
- Multi-component, Multi-station TEM inversion - i.e. Laterally constrained
- New fast but extremely accurate inductive plate algorithm and INVERSION (**available**)
- New MMR modelling tools (**available**)
- Invert for density variations or susceptibility variations within topography (**available**)
- Inversion for freespace plates (**available**)
- New Potential field DFT imaging tools (**available**)
- Extended high accuracy/frequency SPHERE models including conductivity/susceptibility/permittivity contrasts for moving and fixed source surveys including loop,dipole,bipole sources for air,ground and borehole(**available**)
- In development: FSPlate and Sphere models in GNSS space for airborne, ground and borehole surveys
- In development: incorporation of multiple primitives using different algorithms in a single model with direct model computation via AI controls