
The PetRos EiKon News

February, 1998

Version 6 of *PetRos EiKon's* **EMIGMA** Electromagnetic Interpretation Platform

NEW EMIGMA V6.1 RELEASE NOW AVAILABLE !

.... Topography Modelling Now Available!

.... Polyhedral Primitives Now Available!

....DC Magnetics Now Available!

....AC Magnetic Effects on the way!

....Geological Imports on the way!

Full 3D EM Interpretation at your fingertips....

**Direct Data Imports to full 3D visualization of Geological Models
together with 3D views of simulated vs measured data.**

DC Magnetics:

Algorithms have been developed and are being tested not only for DC magnetic modelling but also for the effects of induced magnetism combined with both conductivity and permittivity variations. *PetRos EiKon's* implementation of DC magnetic modelling is unlike the majority of techniques available at present. By extending the LN technique to magnetic effects, we are able to model interactions (unlike potential field approaches to the problem). That is, not only do multiple bodies interact with each other magnetically, but interactions also take place within a single body (so-called demagnetization effects).

In the insert, we model a prismatic target using the Born approach (i.e., assuming that the induced magnetism $M = kH$ inside the body) and the LN algorithm. At low susceptibility ($k = 0.3$) the demagnetization effects are small and the Born weak scattering approach is valid. However, as the susceptibility is increased to $k = 2.5$, the

demagnetization effects are stronger which leads to a reduction in the effective inducing field and hence a smaller anomalous response when these effects are taken into account. Since the Born approach ignores demagnetization (or any type of interaction), the result is about 20% above the LN response at the peak. Notice also that an asymmetry

has developed in the Born response at the higher susceptibility.

This model was introduced to us by Anthony Christensen of WMC, Canada from his undergraduate thesis titled **Magnetic Field Modelling**, University of Queensland, 1991. In this thesis, Anthony developed a

Version 6.1 Release Now Available

Please contact Danielle Parker if you have not received an upgrade installation to **EMIGMA V6** by the end of March, 1998.

2D boundary element code to include full magnetic effects. We have modelled his structure with a long strike length and essentially reproduced his results. Of Course, calculation time for the LN technique will be much quicker than for a finite element technique.

As extensions of *PetRos EiKon's* DC magnetic modelling technique, we plan to offer a full range of magnetic effects, including the combined effects of remanent and induced magnetization.

AC Magnetics - Version 6.2 (May 98)

In our next release. V6.2 we will offer the ability to fully simulate the combined effects of resistivity, susceptibility and permittivity variations.

EMIGMA V6

We are pleased to announce that there has been a significant increase in the use of **EMIGMA** during the last year. This has been not only among the consortium members, but also throughout the geophysics industry. The increased use has kept us busy meeting the demand for modifications and improvements. As a result, we have surpassed our expectations for improvements to our numerical algorithms. Rapid development has also occurred in the areas of Interface and Functionality development, Data Viewing, Data Importing and 3D Visualization.

✓ ILN Prism (Inductive Localized Nonlinear) The right choice for modelling the magnetic field:

- Reproduce results for backgrounds from conducting to insulating.
- Generate stable reciprocal responses from moving source geometries

These improvements, among others, have resulted in a big step forward towards a fully robust Localized Non-Linear Estimator.

✓ LN Prism the strongest algorithm for modelling the electric fields:

New implementations of this algorithm allow measurements within the prism for:

Accurate modelling of electric fields for IP/Resistivity and magnetotellurics by automatic detection of internal receiver positions.

Model sources within your targets for cross-borehole techniques.

✓ **Full Rotational Capability:**

All three Euler angles of solid rotations are now supported in the simulation of Prism primitives.

✓ **Polyhedra LN and ILN Algorithms:**

Arbitrary convex or non-convex polyhedra originally available through the use of topography is now available through both the LN and ILN techniques. Integrated polyhedral manipulators and GEMCOM geological model imports will be available in V6.2.

Multiple Scattering:

EMIGMA now synthesizes a wide range of interactions taking place in electromagnetics.

Simple Superposition

Far-Field Interaction: Includes the primary effects of multiple conductors not in contact

Near-Field Interaction: Ensures current flow between targets and regional conductors in contact with your targets.

Splitting Prisms: When model targets cross layer boundaries, they are automatically split into multiple

prisms/polyhedra and where applicable near field interactions are set

Multiple VHPlates: Multiple thin-sheet VHPlate targets are now supported with a superimposed response.

Magnetotellurics: The implementation of MT in EiKPlot and VisRD makes MT a viable capability.

Direct Topography Imports and Modelling: Topography may now be imported through several formats, polyhedra built automatically to represent the topography and then profiles draped over the topography for direct and easy modelling.

Extended Survey Modelling Capability: RUN settings within Version 6 allow the user to model any number of profiles or boreholes and any number of data components without fear of blowing array bounds. The speed of the layered earth algorithms have been increased by a factor of about 2 with improved accuracy. In V6.2, multiple sources will be allowed within a model survey definition.

✓ Interface and Functionality Developments

New Data Imports: EM37 and EM58 imports have been added to our suite of direct data imports: Crone, Max-Min, UTEM, and EM34. Look forward to AMIRA, GEOTEM and generalized XYZ import routines.

Direct Data Simulation: Direct Data Imports allow for more efficient and more accurate modelling of the field data.

Forward Simulation: Model building has been simplified with the use of direct data imports. Automatic detection of data locations, transmitters, receivers and data channels requires that only the layered earth and 3D model need to be defined by the user.

Transformation: The transform is virtually automated with the use of direct data imports. Base frequency, waveform configuration, ramp times, data channel times and normalization are all automatically selected.

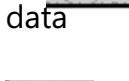
Data Viewing and Comparison:

New Additions to EiKPlot:

- Directly compare field and simulated data in the Plotter and Visualizer .
- Toggle between viewing profiles, components, data types and decay responses.
- Save default settings for rapid plotting of similar surveys.
- Display data coordinates with the click of your mouse.



Scale and Zoom your 2D Plots for easier visual analysis of your

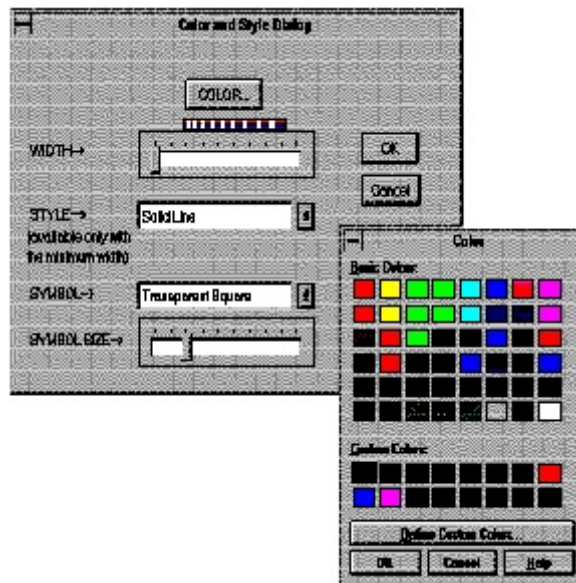


data plotting



Set line and symbol style and colour for presentation quality

Print your plots in colour



Polyhedral Construction:

User Construction: Convert block models to polyhedra through the click of the

mouse. V6.2 will allow for polyhedral manipulation within the Visualizer.

Geological Imports: V6.2 will also bring the first direct importation of your geological model into **EMIGMA** from your CAD tools.

✓ **EMGUI Improvements:**

- Increased stability with the overhaul of the data channel configuration.
- Import ASCII borehole information for hole definition when field data is not imported;
- Improved 3D model definition including the importing of polyhedra (i.e., topography) and the draping of profiles on topography.
- Top Point mode now available in the prism and plate input specification.

Visualization Development:

An essential component to fully utilize **EMIGMA's** simulation capabilities.

✓ **Improved manipulation tools:**

- Sizing and rotation handlers
- Add, split and copy prisms
- Represent material properties with object and colour control interfaces.
- Zoom and Pan controls
- Controlled 2D perspectives
- Camera and view angle control
- View the exact 3D coordinates of any spatial point within the model.

Post-Processing:

Automatic Post-Processing of magnetotelluric simulations to tensor impedances is now available in **MT EMIGMA**. Rotations of the MT tensors are provided in **EiKPlot** as a first step in adding our decomposition software to the plotter

Exports of the MT impedances can be made to the SEG .edi format.

Post-Processing of CSAMT simulations to scalar impedances can be performed as is the normal procedure to display field data.

View MT and CSAMT impedances as apparent resistivities or Phase in both **EiKPlot** and the Visualizer.

Note: Electric and Magnetic field calculations for both MT and CSAMT are maintained and may be displayed. Direct conversion to Apparent Resistivity for dipole-dipole, IP, and moving TEM surveys is coming in V6.2 Pseudo-Section contouring also to be ready for V6.2.

Simple 3D Grids and Polyhedral Manipulation:

User control of the resolution and viewing of the grids for the polyhedral sample points is provided within VisRD. This is a first step to the viewing and manipulation of arbitrary grids and volume data.

✓ **Data Representation:** Import a file into the Visualizer to view measured and simulated data in a variety of means, all within a 3D view of the model.

- Semi-animation of data channels allows stepping through time windows or frequencies
 - Line and Vector Representation of Data
 - Complex 2D Gridding of Surfaces and 2D or 3D Contouring
 - Represent the data as a wave surface
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Notice: New Functionalities are now Keyed

The Polyhedra and Magnetics are now keyed to your software dongle. If you are licensed for these tools passwords, update software and instructions will be provided to you. Please contact Danielle Parker if you need any assistance.

PDAG March 8-12, 1998 - Come visit our booth!

PetRos EiKon Inc. will be exhibiting at this year's Prospectors and Developers Association Conference In Toronto. We welcome the opportunity to arrange for demonstrations or training during your visit to Toronto. Please call to schedule a time.'s

LOOK FORWARD TO:

- Cross-Borehole Imaging and Tomography
- Import GEMCOM polyline files to simulate your geologist's models.
- 1D- Layered Earth Inversions
- Multiple Loops for Ground and Borehole data
- Easier and more direct setups for Dipole-Dipole systems with several TX/RX configurations.
- Translation of data definitions into material properties for Induced Polarization Modelling
- Import model constructions between different modelling projects to enhance fluid data interpretation between different surveys.