The EiKon News
News from ***PetRos EiKon*** Incorporated
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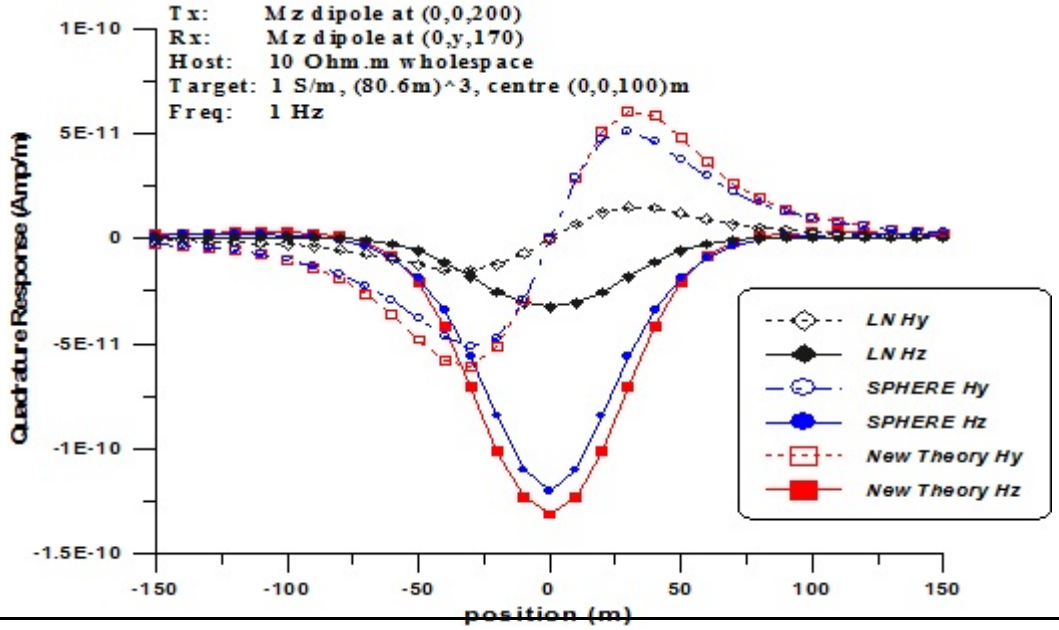
Focus:: Improved Induction

Beta 2 release of Version 5.1 of ***PetRos EiKon***'s **EMIGMA** electromagnetic simulation platform slated for November includes powerful new algorithms for improving the modelled inductive response.

This issue reports on some results obtained using a new theory for improved induction developed at *PetRos EiKon*. The *LNPRISM* algorithm (as it is currently implemented in **EMIGMA V4**) is accurate only when the scatterers are energized in a current channelling mode or when the excitation is weakly inductive (the response to a strong inductive coupling tends to be underestimated). Our new theory provides an extension to inductive modes while retaining the speed ,i.e., O(N) complexity, of the *LNPRISM* technique (Habashy *et. al.*).

Two test models are based upon a research note authored by Ross Groom and Brian Spies at Schlumberger-Doll Research in 1991 which helped initiate the LN research. The configuration used in **Figure 1** is simply a cube in a conducting wholespace (conductivity contrast 10:1). A vertical magnetic dipole (oscillating at 1 Hz) is located directly above the target, so that the coupling is almost purely inductive. The response is dominantly quadrature and is fully contained in the scattered field components H_y and H_z along the indicated profile. A sphere is used as a benchmark (**EMSPHERE** by ***PetRos EiKon***) as this solution is known to be very accurate through a wide range of physical attributes. The difference in the results between **EMSPHERE** and the new LNFD routines are small enough to be simply geometrical effects: the cube is approximated by a sphere of equal volume (i.e., of radius 50m) for the purposes of comparison. [In reference to the *LNPRISM* and new theory approximations, the cube is equisampled rather densely at 7x7x7 since the anomaly is relatively near-field.]

Figure 1:



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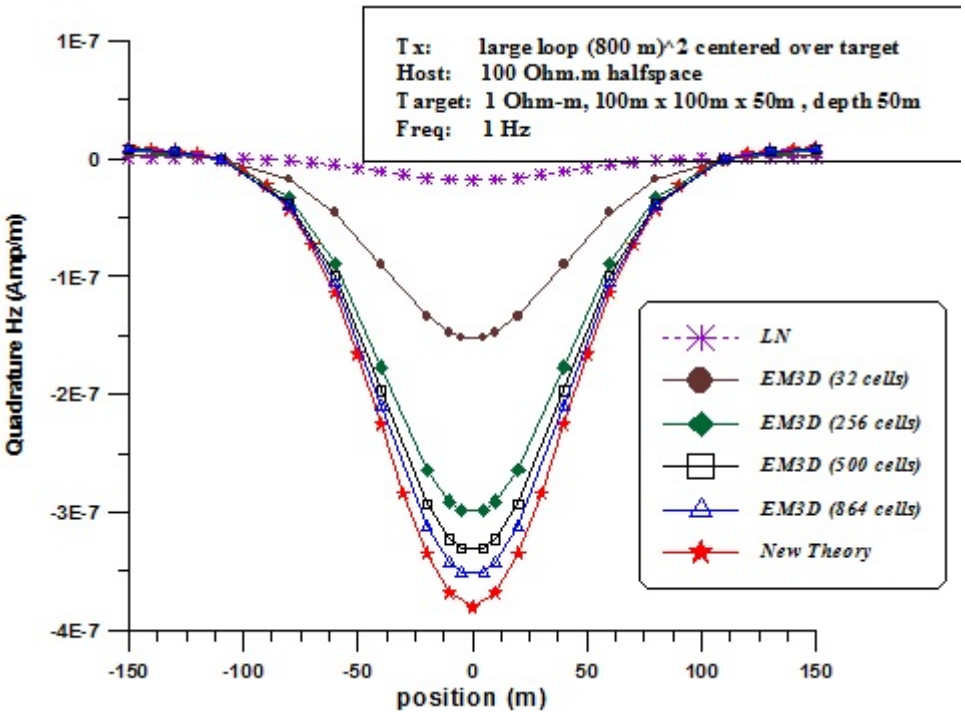
Convergence Model:

Next, we consider a model with a loop inductive excitation *(***Figure 2**): a block of conductivity 1 Ohm-m resides in a 100 Ohm-m halfspace. The receivers are located at the surface and the profile bisects the target. Note the slow convergence of the University of Utah's EM3D solution. Whereas the peak estimate of H_z from our new theory is only altered by around 0.5 % in increasing the sampling from 75 to 108 points (only the former is shown). Applying convergence tests indicates that the EM3D solution will eventually converge on the LNFD solution should enough points be used. The related issue of computation time is very important. The time to calculate the LNFD model on a DX4 is about 5 minutes while the computation time of the (most densely sampled) EM3D model on a Sparc 5 is about 40 minutes. In addition, the EM3D makes use of four-fold symmetry, while the LNFD does not. If symmetry is not used (for example, if the model was not symmetric) the EM3D computation time is further increased by a factor of 64. Thus, the real comparison to the $O(N^3)$ is 1:500 from a CPU consideration. However, the temporary matrices for LNFD are very small while the temporary scattering matrices for $O(N^3)$ become prohibitive after 1000 cells when memory page swapping starts to add significantly to the real time for computation. Inf fact, if symmetry is not used in EM3D for the 864 cell model then on a Sparc 5 with 32 Mbytes of memory, the model takes several hours and still accuracy would be missed at the peak.

Figure 2: Convergence Model



VHPLATE to LNFD Algorithm Comparison:

While the first two model configurations represent almost pure induction at low frequency, this final comparison (see inserts **Figure 3** and **Figure 4**) is even more conclusive particularly for some mining applications. Here we chart the frequency response of a 1000S plate embedded in a 500 Ohm-m host. At this contrast, a strong inductive scattered response is generated. The sampling for the new theory is a mere 25 points. *VHPLATE* is utilized as a benchmark solution. Again, computation times are important. The time to calculate the LNFD response is about 4 minutes while the computation time for *VHPLATE* is a little over 10 minutes. As can be seen from the computation times, the new algorithms are significantly faster than even thin-sheet algorithms designed in the last decade specifically for speed. One other important issue is that *VHPLATE* is of a traditional numeric design type utilizing polynomical basis functions. When the source begins to be close to the target (close proportional to size) then the accuracy of the solution begins to break down. This is not the case with our new solution technique.

Dr. Ian Murray

Notice : August Release of EMIGMA V4

As promised, this month we are releasing **EMIGMA V4** as our MITEC Year 2-end delivery. With this release, we are including a demonstration version of some of our new tools: **EiKPlot V1** for x-y plotting and **i3D Vi∮RD**, a model visualization and examination tool which are featured additions in our **EMIGMA V5**. [Please keep in mind that these new tools cannot be used in DOS but are released for either Windows 95 or NT]. For non-MITEC licenses, this release is included as part of your maintenance contract.

EMIGMA V5 - Beta Release

EMIGMA V5 is on target for release in Beta form at the end of September. We are excited about this new faster, more powerful, and easier to use simulation package. **EMIGMA V5** will feature a fully integrated design where *LNPRISM*, *VHPLATE* and *FSEMTRS* execute under one fully integrated **EMIGMA** platform. Throughout this year, other modelling and inversion tools will be added. The user interface provides a variety of GUI tools including wizards, drop-down menus and dialogue boxes. The new tools, **EiKPlot** and **i3D VI∮RD**, as demonstrated with Version 4, are integrated into the **EMIGMA V5** platform. You will now be able to build and view your model through **i3D VI∮RD** with direct connections into our specially designed property-sheet GUI interface for model buiding. After executing the forward codes, the user can directly and rapidly plot the results of the response in **EiKPlot**. Direct import of data is provided and model building can begin from survey characteristics imported through your field data files. Direct and easy-to-use plot comparisons are provided throught **EiKPlot.**

EMIGMAV5 is a multi-threaded application and as such will take advantage of multi-processor machines. This design also provides stabler execution if you have only one processor. In addition, all memory, including memory for the forward modelling algorithms, is dynamically allocated utilizing and releasing memory as required. All the numerical tools are split into several .DLL's and threaded with their own memory allocation.

➪ Some of the look of V5 is shown in the inserts.

VHPLATE and MITEC Project Year 3

Currently **EMIGMA** allows you to build models which contain both a plate and multiple prisms; however, the response is simply superimposed. We are now developing the ability to model the combined response of interacting multiple prisms and plates. This will allow you to simulate more accurately the response of your targets; but, the software is smart, utilizing the interaction only if requested or required. With this development comes the capability to model multiple plates as well as plates contained within prisms. These new capabilities will allow you to build more complex and accurate models, however, to use both prisms and plates (including the new LNFD prisms), the user will be required to have a license for both *LNPRISM* and *VHPLATE*. Both *LNPRISM* and *VHPLATE* with upgrades are offered at an attractive price at present.

We are reaching out to the world

➪ Look for our new HomePage on the internet at Web site:
http://ourworld.compuserve.com/homepages/PetRosEiKon

We will be setting up a chat line through the web that will allow you to share your experiences with other users of **EMIGMA**.

✎ Reminder Maintenance Contracts ✎

Many of you still have outstanding maintenance contracts. Maintenance is offered at industry standard rates (15% of the current value). Special rates are available for MITEC sponsors on their additional *LNPRISM* licenses. We also offer Corporate Maintenance contracts for clients with multiple licenses. Please note that allowing your maintenance contracts to lapse will lead to a loss of support and upgrades.

☎ Please contact Danielle Parker to renew support on your licenses.