dGB++ Newsletter of dGB

September 2004

dGB++

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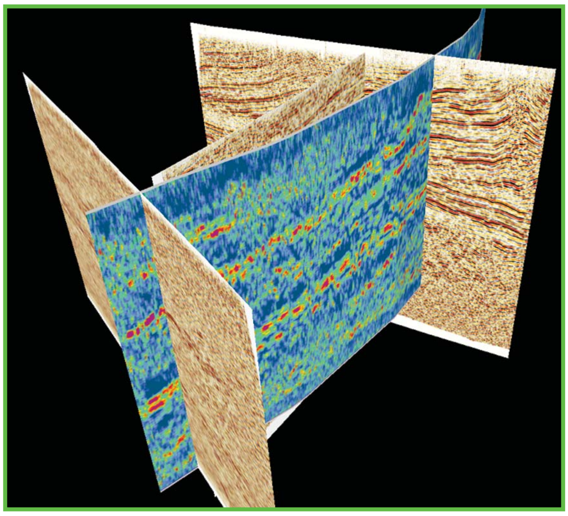
New Developments



2D lines are mapped at actual X,Y positions.Courtesy ENAP/Sipetrol

Conferences:

SEG, Denver, booth 1818
10-15 Oct. 2004

AAPG, Cancun
24-27 Oct. 2004

IN THIS ISSUE

Spectral Decomposition (dGB++ March 2004 and page 4 in this issue) marked the onset of a new era for developing high-tech seismic applications faster and cheaper than ever before. The project was scoped out, financed, developed, tested and released all within a time span of six weeks. Revolutionary about the project was that the sponsors agreed to release the final product as open source, hence benefitting the entire OpendTect community. The same mechanism for sponsored development is presently used for 2D OpendTect and OpendTect SSIS (Seismo-Stratigraphic Interpretation System). Sponsoring helps us to prioritize the wishlist and to meet our users' needs. Sponsored projects may lead to extensions of OpendTect base, commercial plugins as well as proprietary code.

Set priorities on the wishlist by sponsoring projects

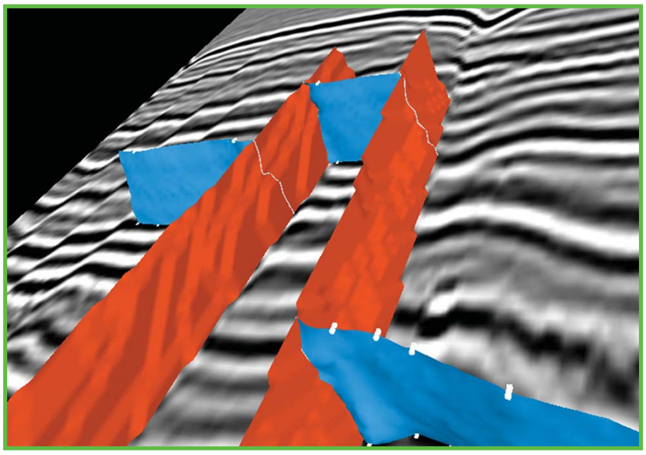
2D in OpendTect

Statoil sponsors the development of 2D seismic data support within OpendTect. This extension enables seismic attributes, chimneys, faults, dip-steering etc. to be calculated on individual lines or entire line sets. 2D lines can now be evaluated in conjunction with your 3D data.
2D OpendTect will be (pre-) released as open source in version 2.0 in October 2004.

Tracking and OpendTect SSIS

The release of seismic horizon and fault tracking functionality promises to lift OpendTect from a niche product to a mainstream trace interpretation system with unique attribute and pattern recognition capabilities. In the new tracker multiple horizons and faults are tracked simultaneously in a geometrically consistent way thus reducing post-interpretation editing efforts (dGB++ March 2004) The tracker is (pre-)released as open source in version 2.0 in Oct. 2004.

OpendTect SSIS is an R&D project with TNO, BG and Statoil that aims at developing new tools for seismo-stratigraphic interpretation. In SSIS the tracking software is extended to tracking sequence boundaries (unconformities) and intermediate horizons to enable interpretation in geologic time. SSIS is a two-year project that will lead to new commercial plugins to OpendTect.



Surfaces grow without overlaps and gaps.

Company news_

New Associates
dGB initiated a new scheme to enable private consultants and 3rd party contractors to use our software products in collaboration with dGB. Associate agreements were recently signed with VI consultants (Hugo Poelen), Dakon Technologies (Jeremy Fu) and SoleGeo (Paul de Beukelaar).

Baby Boom
Congratulations to Menno and Claudia Dillen with the birth of Marie Sophia, Herald and Merel Ligtenberg with the birth of Jaïra and Larinde and to Tanja and Cor Oldenziel with the birth of Floor.

Academic Licenses
To promote R&D dGB offers Universities free access to GDI and the commercial plugins to OpendTect: dip-steering, neural networks and workstation access. The latter is graciously offered by Ark-cls. The scheme has become very popular since the release of OpendTect and its Open Source development possibilities. The following Universities are currently benefitting from the scheme:

- NCPGG Adelaide
- Federal University of Rio de Janeiro
- Technical University of Delft
- University of Aswan
- NTNU in Trondheim
- University of Southampton
- Dokuz Eylul University
- University of Cardiff
- University of Tromso
- P.U.C. Rio de Janeiro
- Virginia Tech
- UCLA at Berkeley
- University of Oklahoma
- McGill University
- University of Texas
- Heriot-Watt in Edinburgh
- University of New South Wales
- University of Utah
- West Virginia University
- International University of Bremen
- Leeds University
- Curtin University of Technology
- Institute National de Poly-technique de Lorraine
- China University of Geosciences
- Universidade do Estado do Rio de Janeiro
- Institute Technology Bandung

Developing software in OpendTect

Making software using OpendTect is in principle pretty easy. The three main options are:

API. Use OpendTect libraries. This is the most uncoupled way to use OpendTect functionality. It allows re-use at every level. You will have to manage the libraries you use and you cannot work 'inside' OpendTect in this way. Further, everything more than batch-type or simple GUI work (Qt-based) will be hard to use.

Source code change. It is possible to change the software by modifying existing classes and functions, and adding extensions to the libraries. The advantage is total control. The problem with this approach, however, is that you must keep the modified OpendTect sources in sync with new releases. Furthermore, if you cannot convince the opendtect.org staff to adopt the modifications, other OpendTect users may not be able to use the work.

Plugins. To overcome the above problems OpendTect supports a plugin architecture. Plugins make use of all the facilities of OpendTect but are loaded at run-time and can therefore be developed in a completely independent way. One thing a developer cannot do, is to use another compiler. OpendTect is built with gcc/g++. Switching to another compiler means that all OpendTect libraries, and supporting libraries (in particular Qt and COIN) have to be rebuilt.

Plugin basics
In OpendTect, the entire task of dynamic library querying, opening and so forth is already programmed. A plugin only needs to contain a few standard functions. Let's say the name of the plugin is MyMod, then these functions are:

```
GetMyModPluginType
GetMyModPluginInfo
InitMyModPlugin
```

Only Init...Plugin is mandatory. The first one, Get...PluginType determines whether the plugin can be loaded with OpendTect's auto-load mechanism, and if so, when. 'When' means: before or after the program has created the OpendTect GUI objects (and always after the static objects are initialized). The Get...PluginInfo function simply provides info for the users of MyMod plugin.

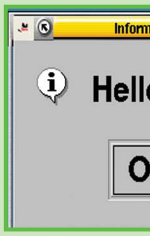
Hello World!
The well-known 'hello world' case shows how to take the first steps in any system. The OpendTect plugin that does the most basic 'Hello world' looks like:

```
#include <iostream>
extern "C" const char*
InitHelloPlugin( int, char** )
{
  std::cout   << "Hello world!"
              << std::endl;
  return 0;   // All OK - no
             //error messages
}
```

The Makefile to build the plugin looks like this:

```
SRC.cc := hellopi.cc
PLUGIN := yes
include make.od.Defaults
include make.Targets
```

Ensure the OpendTect Make system Pmake is initialized and try ‘make -n’. The plugin is generated and can be loaded from within OpendTect (Menu Utilities-Plugins; 'Load new'). The message 'Hello world' should appear on stdout (on Windows, stdout messages appear on the OpendTect console window).



To make this a UI - based program we will use the uiMSG() utility:

```
#include "uimsg.h"
extern "C" const char*
InituiHelloPlugin( int*, char**
)
{
    uiMSG().message(
           "Hello world!" );
    return 0;
}
```

After loading, a popup message appears with an OK button. In this case the OpendTect libraries are used, which means that the Makefile needs to be changed by adding:

```
MODDEP := uiBase
```

GUI classes and seismic data

The uiSeisIOSimple was created to be an example for these to issues. The plugin loads or dumps seismic data in simple flat file formats and comes with the release as a useful plugin example.The first thing we note is that the plugin's source is in multiple files. The top-level plugin functions are in uiseisiosimplepi.cc. These functions make use of classes implemented in uiseisiosimple.{cc,h} - the user interface, and seisiosimple.{cc,h} - the 'real work'.

In uiseisiosimple.cc we can see the way a GUI is built. The general concept is to define elements that are attached in one way or another, like in:

```
isxyfld = new uiGenInput( this,
        usrtxt, BoolInpSpec(
       "X Y","Inline Xline") );
isxyfld->setValue(data().isxy);
isxyfld->attach(alignedBelow,
        haveposfld);
```

We see an input field that gets a bool from the user with the specified texts. It is attached to a field above it. In this way, windows are not painted explicitly but the layout is determined on run-time. This is very flexible and easy to use and it allows all kinds of dynamic and adaptive GUI building.

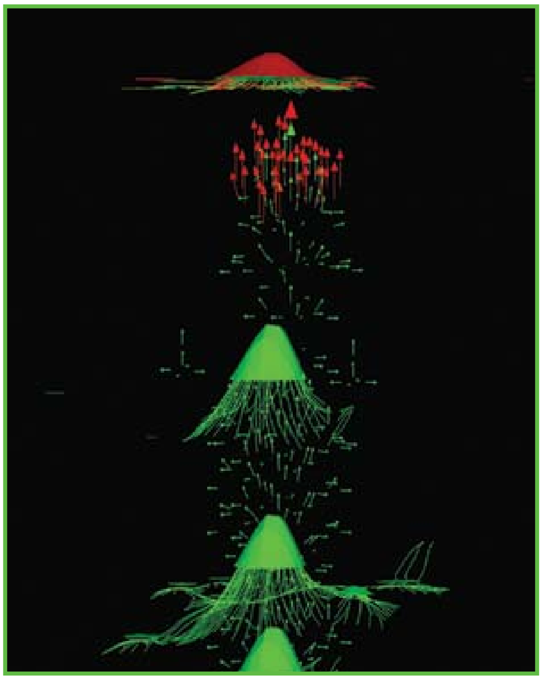
In seisiosimple.cc the 'real work' is done. Central here are the SeisTrcReader and SeisTrcWriter classes. Both need an instance of the IOObj class, which encapsulates the way OpendTect manages data objects. IOObj instances are usually obtained from the IO Manager IOM() by providing it the unique key to the object. Tools that select existing entries in the IO database or create new ones are present.

Conclusion

Although there are other ways to develop software using OpendTect, making plugins is an attractive maintainable option. The plugin system itself is easy to use; to use the OpendTect classes themselves requires the mastering of the basic concepts underlying OpendTect, like the GUI classes and the IO Management system.

Seismic Basin Modeling Group

Seismic fluid migration paths visualized by OpendTect's multi-attribute, neural network object detection technology has been used successfully for integrating seismic information with basin modeling (e.g. dGB++ March 2004). Many seismic interpreters believe that aside from fluid migration paths more information can be retrieved from seismic data to assist basin modelers in creating better models. However, the concepts are still very new and much remains to be learned.



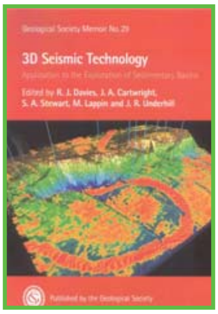
Modeled accumulations in stacked reservoir. Courtesy IES GmbH.

To advance the technology Herald Ligtenberg recently initiated the creation of a seismic basin modeling group. The group was set up to exchange information, tap knowledge, share experiences, float new ideas, post questions, start discussions, organize meetings, and so on. To become involved and to be kept up to date with the latest developments, please sign up for the basin_modellers@OpendTect.org mailing list, see www.OpendTect.org. Already 89 geo-scientists have signed up including basin modelers from software providers IES and Permedia.

A start-up meeting will be held at the AAPG conference in Cancun. Date, time and venue will be announced on www.opendtect.org. For more information, please contact Herald.Ligtenberg@OpendTect.org.

Publications

The following is a selection of recent publications and forthcoming talks by dGB staff.



Books

De Groot, P. et.al., 2004. Examples of multi-attribute, neural network-based seismic object detection. In Geological Society Memoir N0. 29 - 3D Seismic Technology. Editors Davies, R.J. et.al.

Papers

De Groot, P., Aminzadeh, F and Hemstra, N.. 2004. OpendTect, seismic interpretation with a difference. Clusterworld, Oct. 2004.

De Groot, P. and Aminzadeh, F., 2004. OpendTect: Open Source, Platform Independent, Visualization and Interpretation System. SEG convention, Denver - Visualization Special Session.

Walraven, D., Aminzadeh, F. and Connolly, D., 2004. Predicting Seal Risk and Charge Capacity using Chimney Processing: Three Gulf of Mexico Case Histories. SEG convention, Denver 2004.

Posters

Aminzadeh, F. and Connolly D., 2004. Hydrocarbon Phase Detection and Other Applications of Chimney Technology. AAPG Int. Conference, Cancun, 2004.

Ligtenberg, H., 2004. Fault Seal Analysis by Enhancing Fluid Flow Paths and Fault Irregularities in Seismic Data. AAPG Int. Conference, Cancun, 2004.

Spectral Decomposition

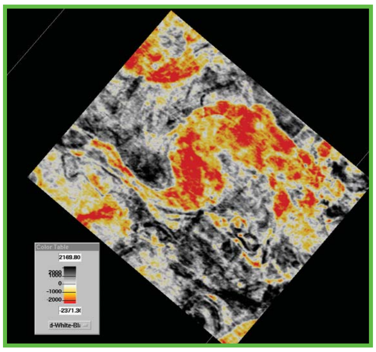


Fig. 1. Amplitude slice.

Spectral Decomposition (SD) is a powerful tool for "below resolution" seismic interpretation and thickness estimation. In SD spectral properties, or scale properties are extracted from a small part of the reflectivity series through mathematical transformation. As a consequence of the small transform window the spectral response of the geological column is not "white" but contains effects such as spectral notches and tuning frequencies that relate to the local reflectivity only, hence to geological properties such as layer thickness and stacking patterns. The (combined) spectral slices highlight subtle features, often below seismic resolution, which would escape the interpreters eye if (s)he would be working with amplitude information or single attributes such as energy or instantaneous frequency alone.

Open source SWFFT and CWT transforms

OpendTect

OpendTect supports SWFFT (Short Window FFT) and CWT (Continuous Wavelet Transform). The SWFFT calculates the Fourier spectrum in a short window around a horizon (and in volume mode it uses a running window). In the ideal case this window should encompass one seismic event, which may be a superposition of multiple geological events which interfere in the seismic trace. The CWT maps the seismic trace on wavelets of different scales. In OpendTect spectral decomposition is applied in the “Attribute Set” window by pressing the “Evaluate Attribute” icon and specifying the number of frequency (wavelet scale) slices to be computed. Typically some 30 slices are computed which are inspected in a movie-style manner. Output cubes of selected frequencies (scales) can be created for further study

Example

An important application of SD analysis is to interpret stacked channel systems and analyze the interrelations of the different components of the channel system, from braided channel complexes, to individual channels and the channel’s elements. The connectivity of different subelements can be inferred and pressure boundaries and compartmentalization can be mapped on the spectral decomposition results. If pressure data from production become available these results can be cross-checked and refined with the pressure data from the different wells.

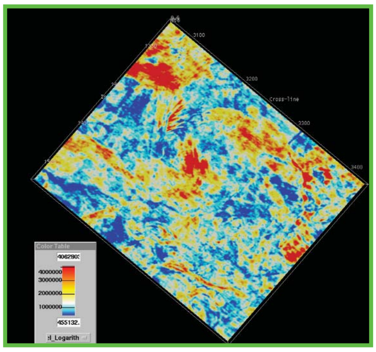


Fig. 3. Energy slice.

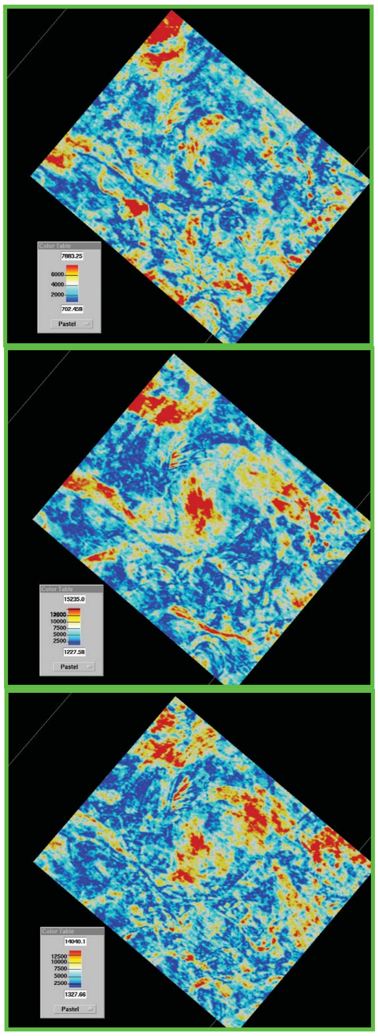


Fig. 2. SD slices at 15 Hz (top), 45 Hz (middle) and 75 Hz (bottom).

A meandering river system is decomposed into several spectral slices. Fig. 2 shows the SD slices at 15, 45 and 75 Hz. In each of the slices we see that outside the main channel several features brighten up, which were not apparent from the amplitude section (Fig. 1). This gives a much better appreciation of the paleo-landscape, with smaller channels and oxbow lakes surrounding the main channel body. It is seen that within the main meander different areas brighten up at different frequencies. This may indicate variations of thickness within the channel (hence good connectivity), or maybe the channel is composed of sedimentary sub-bodies (possibly indicating poor connectivity), some of which may be deposited during catastrophic events (flooding), since the anomalies cross the outer boundaries as observed on the amplitude section. For comparison the energy attribute is shown in figure 3. Many features show up, but the complete picture is far less clean as the spectral slices and in addition the attribute does not carry any scale information.

Suggested reading: Partyka, G., Gridley, J., and Lopez, J., 1999, The Leading Edge Volume 18, Issue 3, p. 353.

Mailing list

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