BOTOSEIS: A new Seismic Unix based interactive platform for seismic data processing

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Abstract

After eight years of the first distribution of the user's manual of the Seismic Unix (SU) package, it is yet a challenge to execute some seismic processing SU scripts, especially for inexperienced users. Up to now there are few possibilities to have friendly user graphical interface for the Seismic Unix (SU) package, namely Tksu, iSU and GêBR. In order to obtain a more robust and flexible way to work with the SU package, we present a new graphical user interface, called BotoSeis, written in the Java programming language, which can be used under any operational system that have support for Java. It is adequate to be used both as a production or as an interactive development environment, by creating and managing projects, lines and flowcharts of seismic data processing. It is also possible to add SU programs, interactively, without knowledge about any programming language. The BotoSeis platform is structured by modules, which can be a single application or a combination of SU programs to produce a more complex result, e.g., the special modules called iView and iVelan. The former is a GUI developed for data visualization, and the later is an important interactive tool for velocity analysis, fitted for production and educational environments.

Introduction

The Seismic Unix (SU) package was developed with the initial support of the Society of Exploration Geophysicists (SEG) and the Gas Research Institute (GRI). Nowadays it is supported by the Center for Wave Phenomena (CWP), Colorado School of Mines, United States of America (USA). It is a collection of hundred independent programs, written mainly in C language, which extends the Unix operating systems to seismic processing, production and research tasks, completely distributed as an open source code project (Cohen and Stockwell Jr., 2000). With the SU package, fundamental techniques for seismic data processing (e.g., spectral analysis, F-K filter, velocity analysis, NMO-DMO stack, deconvolution, migration and others) are applied through command lines or script files. Due to this fact, students or professionals without experience in the use of a unix terminal or scripts have difficulties in using the SU package. Even so, the SU package has been very successful in the geophysical community.

In order to facilitate the access to the SU applications, the graphical interfaces Tksu, iSU and GêBR were developed. The Tksu was written in the Tcl/Tk language, it is a graphical environment to build, interactively, seismic processing flowcharts. The iSU GUI has as the main feature the possibility of execution of single process or a sequence of them. The GêBR software was developed by using GTKmm tool at Campinas University (UNICAMP), Brazil. It is adequate to manage projects and seismic lines, and also to create, execute and manage flowcharts.

At the Federal University of Para (UFPA), Brazil, since 2003, researchers have implemented projects to develop graphical user interfaces for the SU package intended to be used during the courses on seismic data processing. As a result of this endeavor we present the BotoSeis platform. The name Boto refers to a legendary fish from the Amazon river frequently used as main character of local tales.

Besides the SU package, the BotoSeis platform includes two interactive modules (iView and iVelan) that are special tools based on SU applications. With iView it is possible to obtain different visualization modes of multiple seismic sections, it has, also, dialog boxes for applying gains and viewing headers of the seismic traces. The iVelan is a GUI software based on applications for interactive velocity analysis in common-midpoint seismic domain, the so-called CMP method.

Botoseis Platform

Tthe BotoSeis platform is a collection of softwares written in the Java programming language with a graphical environment to create and manage projects, lines and processing flowcharts. In order to make easier its application, the BotoSeis preserves some characteristics of well-known seismic data processing package. The BotoSeis user can create, manage and execute projects, lines and flowcharts from only one interactive environment. Within flowcharts, the seismic data processes can be interactively inserted, moved or excluded.

The BotoSeis platform offers the following possibilities: *1) visualization of projects, lines, flowcharts and group of programs; 2)visualization of programs grouped in categories; 3) dialog window to insert parameters of the SU programs in a flowchart; and 4) visualization of errors and log files to verify the process*.

The main GUI help the user on the creation and management of projects, lines and flowcharts. Also, it is possible to move, exclude, add SU processes in the flowchart, execute and stop a given process. The BotoSeis allows the inclusion of SU modules or other Unix based programs in the interactive work environment.

In the Figure 1 is shown the main work environment of the BotoSeis platform. On the upper left we show the window for management of projects, lines and flowcharts and in the bottom the work place for selecting SU or others programs. In the central part there is a place to build flowcharts with options to run, pause, and kill a process, and also to obtain general information about the processes executions. On the right we have the window to insert the parameter for process. In the Figure 2 we show tool boxes to add interactively new programs in the BotoSeis platform, very important for customizing the work environment. In Figure 3 we have an example of execution of the BotoSeis platform.

Interactive Modules

The philosophy behind the BotoSeis platform development is to make possible the expandability and flexibility of the SU package in only one interactive environment, preserving the open source code characteristics. For that, BotoSeis is structured by modules that can be a single or a combination of SU applications. In order to produce a more sophisticated result, we present in this section the iView (Lima et al., 2006) and iVelan (Lima et al., 2007) softwares.

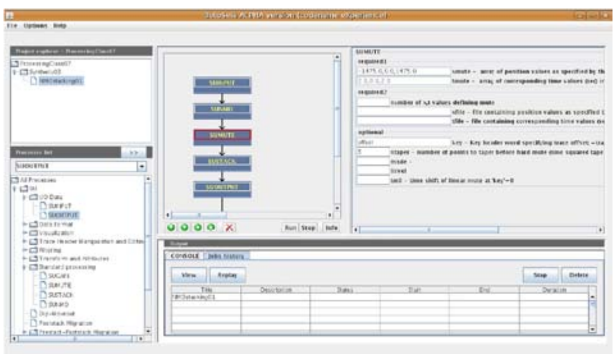

Figure 1: The main work environment of the BotoSeis platform with flowchart and dialog box for parameter edition and management of process and SU applications.

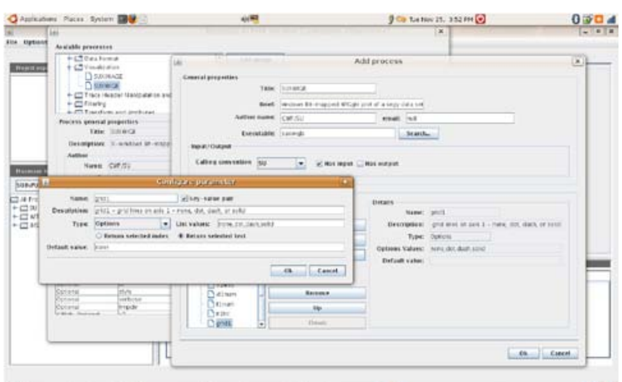

Figure 2: Tool boxes to add interactively new programs in the BotoSeis platform.

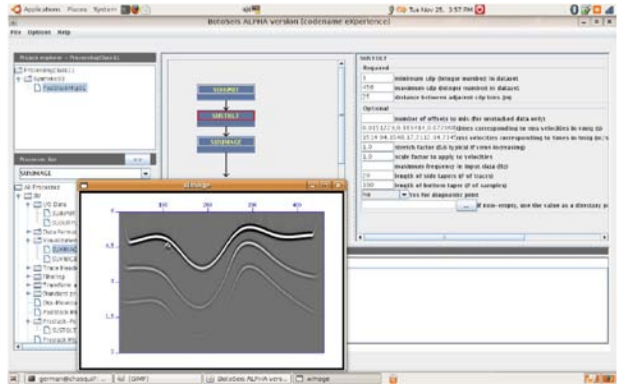

Figure 3: Example of execution of the BotoSeis platform.

iView software

The iView is a tool for the visualization of seismic data, with the functionalities of the three SU visualization programs (suximage, suxwigb, and suxcontour) in only one graphical interface. It was written initially in the C++ programming language. Currently, the iView is being rewritten in the Java language. This interface provides a more robust and flexible data visualization tool, by using the same advantages of the SU softwares.

By using the iView the following tasks are available: *1)Visualization modules by image, wiggle, contour, image+wiggle and image+contour*; *2) visualization of multiple sections; 3) zoom tool; 4) dialog boxes for header display and gain application.*

In Figure 4, we can see the class diagram of the iView, with the input and output data structure for various types of presentation of the seismic data. In Figure 5, we have an example of the image+wiggle visualization mode using the iVIiew. It is important to point out that these results are fully based on the SU package. In Figure 6, we show the trace visualization in wiggle module, with headers information displayed by a dialog window that is activated by a mouse click at the desired trace.

iVelan software

The iVelan is an interactive software for velocity analysis using the common-midpoint technique. Like iView, It is also based on combination of SU programs. Its first version was written in C++ programming language, being recently rewritten in Java to guarantee the desired portability. The interactivity necessary to do the velocity analysis was reached by using flexible graphical interface, based on SU codes, that are organized in classes by means of a central work environment.

The main features of the iVelan are: *1) Selection and visualization of CMP sections into a given interval; 2) image visualization of semblance coherence panel; 3) images of stacked traces from nearby CMP data section by using constant velocity, the so-called constant velocity stack (CVS); 4) visualization of the hyperbolic curve on the CMP section as the mouse pointer moves in the*

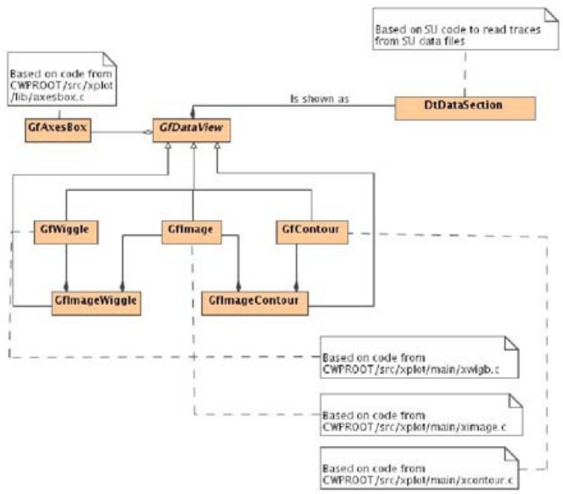

Figure 4: The class diagram of the iView, with the input and output data structure for various types of presentation of the seismic data.

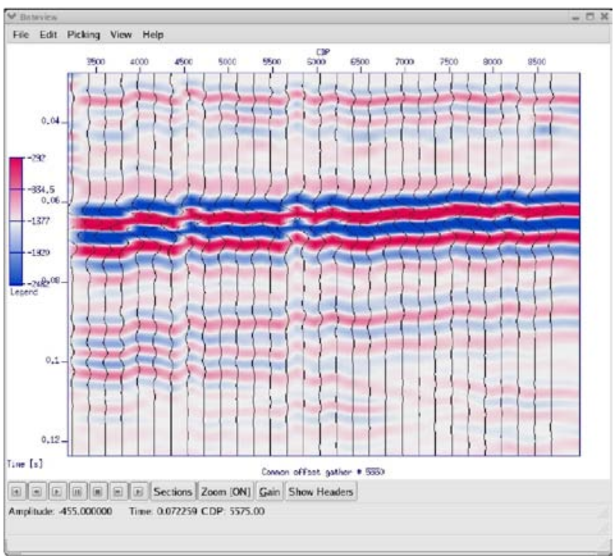

Figure 5: Example of visualization module image+wiggle by using the iView software.

image of coherence (semblance) or CVS panel; 5) the option to apply and remove normal moveout (NMO) correction.

An example of application of the iVelan software is shown in Figure 7. On the left side we visualize the CMP data section, the red line is the NMO hyperbole to be fitted on the reflection data for optimal stacking velocity. On the upper left there are buttons to apply, to remove the NMO correction, and to advance for the next CMP section. The semblance coherence image in the central part of the figure is used to define interactively the best stack velocity at each ZO reflection traveltime. On the right of the same figure we have the CVC panel that is built for various CVS values, and it can also be used to define the optimal velocity to apply the NMO correction. In the Figure 8 on the left we can see the NMO corrected CMP data section.

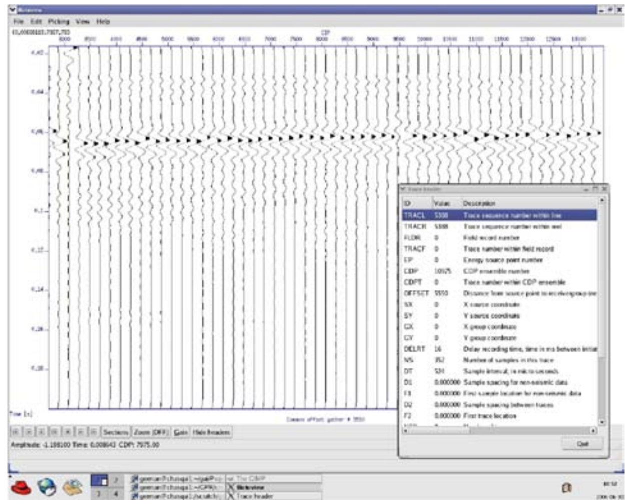

Figure 6: Trace visualization in wiggle module, with information (headers) display.

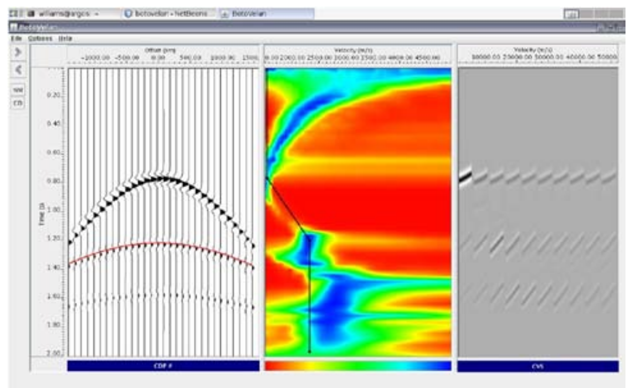

Figure 7: Example of application of the iVelan software.

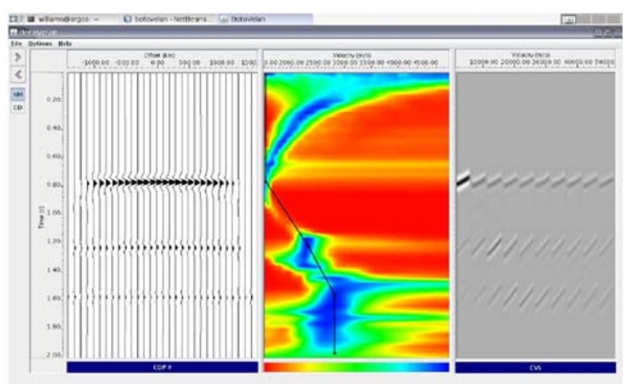

Figure 8: The NMO corrected CMP data section.

Conclusions

In this paper we presented the first versions of the BotoSeis platform, and its interactive modules iView and iVelan. The BotoSeis is a platform for interactive applications of SU programs. The interactive modules are SU based tool for data visualization and velocity analysis, respectively. These softwares can be considered important alternatives for using the facilities of the SU package to do seismic data processing. These softwares are written in Java to facilitate the portability and follow the open source code philosophy like the SU package. They are adequate for students and researchers or other professional interested in seismic data processing developments.

Acknowledgments

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