Hypercube viewer update

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ABSTRACT

Efficient viewing and interacting with multi-dimensional data volumes is an essential part of many scientific fields. This interaction ranges from simple visualization to steering computationally demanding tasks. SEP uses a multi-dimensional slice viewer called `Hypercube`. I describe improvements to the `Hypercube` viewer including rotation, 3-D picking, and the ability to create surfaces.

INTRODUCTION

Viewing and interacting with multi-dimensional volumes is necessary when working with 3-D data. SEP wrote its first movie program 30 years ago and has continually expanded on this initial idea (Claerbout, 1981; Sword, 1981; Ottolini, 1982, 1983, 1988, 1990). These movie programs have progressed from simply showing a series of frames to allowing greater and greater levels of interactivity. In Clapp et al. (2008), a new viewer, `Hypercube`, based on the QT [1] graphics library was introduced. In this paper I describe improvements to the `Hypercube` viewer. I begin by giving an overview of the viewer and then I describe improvements in its ability to do data auto-picking, rotate data, and create surfaces from picks.

UPDATES

A great number of additional features and bug fixes have been introduced since Clapp et al. (2008). In this paper I am highlighting a few of the more useful features.

Rotation

`Hypercube` is based on a regular grid concept. This has the advantage of allowing for simple book keeping, lower graphic card requirements, and makes it more amenable to interaction with applications/approaches that rely on regular sampled functions. It has the disadvantage of not allowing data that does not fit either its grid or line (through pick-sets) data concept. `Hypercube` now allows the grid to be rotated along any plane. The rotation amounts to rotating the griding of the data. The e basic slice

[1] http://www.trolltech.com/products/qt

viewer concept is maintained. As a result, if you rotated your view by 45 degrees you would see a single trace at the edge of the cube. Figure 1 demonstrates this concept.

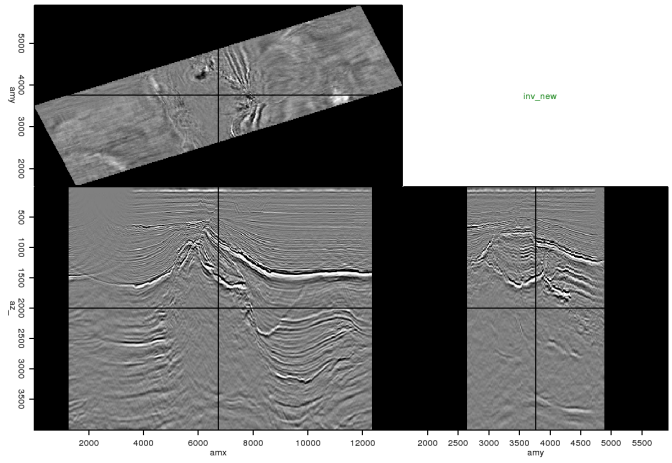
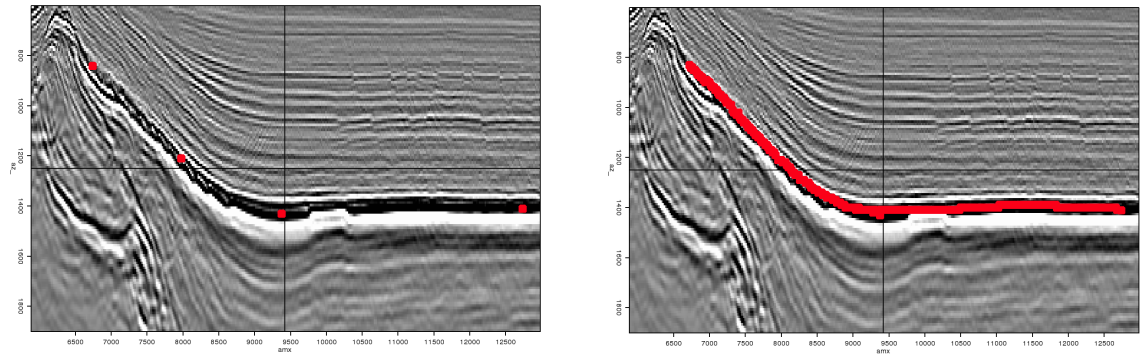


Figure 1: The result of rotating the cube viewing angle. [**NR**]

Auto-picking

Picking every X-Y location is too human-intensive to be practical. As a result, auto-pickers are used to speed up what is still a human-intensive task. `Hypercube` has two 2-D auto picking options. Both of these options use a dynamic programming Liner and Clapp (2004) approach to find the most likely path between a set of user picked points. The difference between the two approach is how the dynamic programming *score matrix* is constructed.

The user begins by selected several points along a given interface (Figure 2(a)).`Hypercube` has the concept of a *single* axis for each pick set. The best way to understand the `single` axis is through a couple examples. When picking NMO velocities you do not want more than one velocity at a given time and midpoint. As a result, the velocity axis would be the *single* axis. When picking surfaces, `Hypercube` forces you to pick an axis (such as depth) where you will not have multiple depths at any given location. The definition of a *single* axis allows the viewer viewer to construct a linear path between pairs of user specified points (the linear path is along the non-single axis). Points are then extracted by taking points that are to either side (along the *single* axis) of the line segments making a 2-D matrix. The 2-D matrix is as wide as the distance between the first and last picked points along the non-*single* axis and is as high as $2nc + 1$, where nc is the user specified number of points to either of the line segment that are extracted. At this stage the two auto-picking approaches (correlation Viteribi and Brown) diverge. In the correlation approach, the score matrix is constructed by cross correlating a vector at a picked location with the vector at the test location. The Brown method (Brown et al., 2006) substitutes amplitude for velocity and uses an Eikonal solver to find the best path between picked points.



(a) (b)

Figure 2: a) Several picks on an inline section. b) The result of using the modified Brown auto-picker on the picks shown in a). [**NR**]

Figure 2(b) demonstrates the result of running the Brown auto-picker on the picks shown in Figure 2(a).

The auto-picker provides some level of 3-D picking through extending a series of 2-D picked lines. Figure 3 show the result of auto-picking three in-lines. The auto picker will loop through the planes perpendicular to picked lines using the specified auto-picking methods to create a dense pick-set. The left panel of Figure 4 shows the result of extending a series of picked lines.

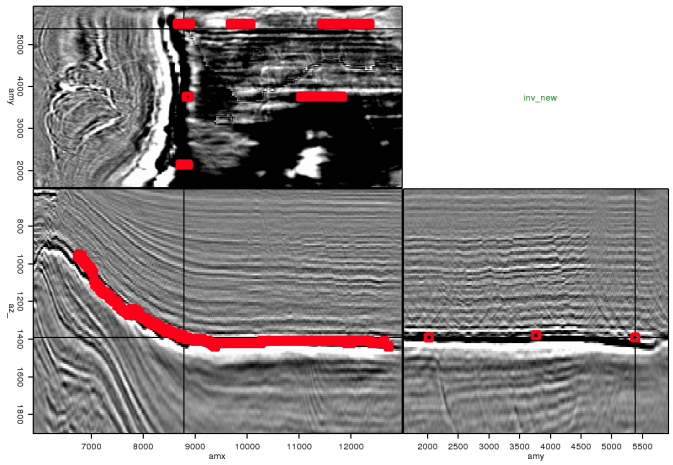


Figure 3: The result of picking two additional inline using the auto-pickers. [**NR**]

Surfaces

Surface viewing is a new option available in `Hypercube` by specifying `do_surface=1` on the command line. A `Hypercube` surface is a new dataset created from a pick-set. It is one dimension less in size than the original data (based on the *single* axis). The values of the dataset are either the location of a pick along the *single* axis or the

amplitude at that location. Figure 4 shows a depth map from a set of auto-picked points. Note how we have depth information only at X-Y locations where we have a pick.

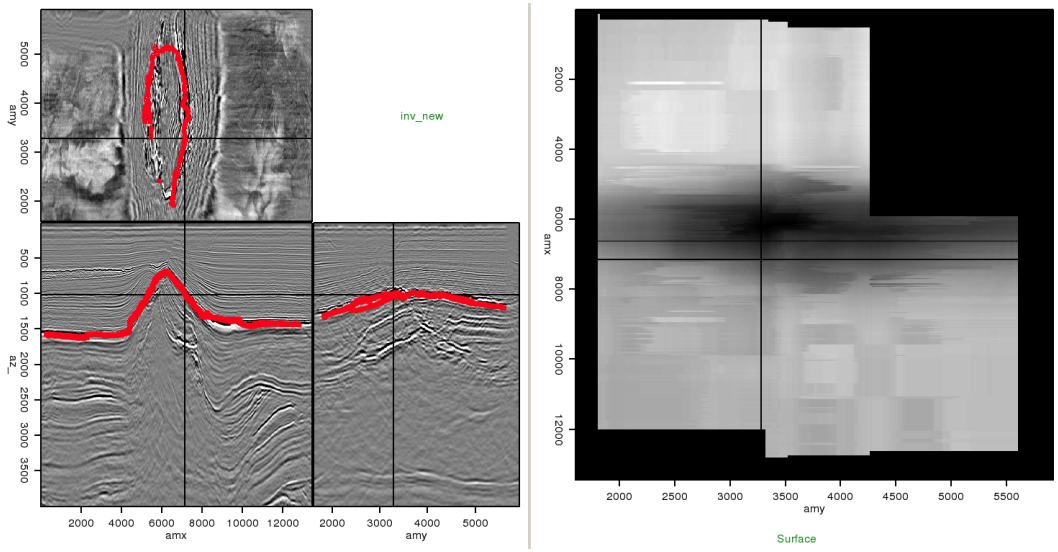


Figure 4: The left panel shows a dense set of picks based on extending three user picked in-lines. The right panel shows the depth of each picked point. [**NR**]

WEBSITE

A technical report is not the best medium to describe how to use an interactive tool. As a result I have set up a website[2] that describes how to install and use the `hypercube` viewer. It contains a complete description of the menu, keyboard, and mouse options available in `hypercube`. It also contains several movies demonstrating how to use a wide variety of `hypercube`'s features.

CONCLUSIONS

SEP's `hypercube` viewer is a powerful tool to visualize regularly sampled fields. The viewer now allows rotation and expanded picking features. A website has been created that describes the viewer in more detail.

ACKNOWLEDGEMENTS

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[2]http://sep.stanford.edu/data/media/public/sep/bob/doku.php?id=hypercube:hypercube

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