Introduction to KeckCAVES Lidarviewer

By Mike Oskin – Revised September 19, 2013

INTRODUCTION: This tutorial is designed to introduce you to how to use keckCAVES LidarViewer software. A full introduction to the software, including installation from source code, is provided on the KeckCAVES wiki: http://wiki.cse.ucdavis.edu/keckcaves:lidarmanual This tutorial uses a pre-compiled binary for MacOS, and sample terrestrial lidar data set from the El Mayor-Cucapah earthquake surface rupture. You will learn to visualize and navigate through the point cloud, make measurements from the point cloud, and select and export point data. Unfortunately, the pre-compiled LidarViewer software does not make the process of generating our own data sets convenient. The programs do exist inside the LidarViewier application and can be used from the terminal. However compiling the software from source (on either Mac or Linux) is the best way to really use the full functionality of LidarViewer and to keep up with updates.

PREREQUISITE

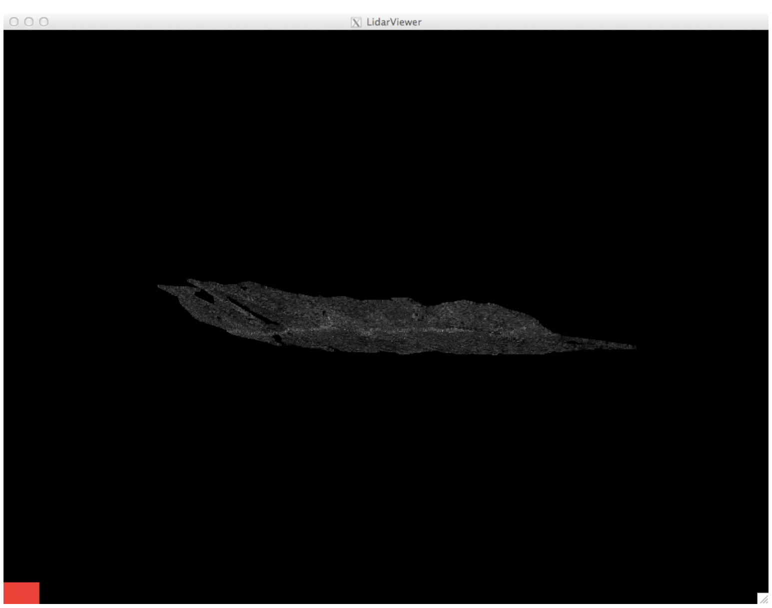
LidarViewer uses the X windows system for displaying on the screen. An install file for XQuartz has been included in the materials for the class. You need to install this before running LidarViewer.

PART 1. Getting Started

Copy the Lidarviewer-2.x application and the sample data set, EMC_TLS.lidar, onto your desktop. The EMC_TLS.lidar folder is a lidar data set stored in LidarViewer octree format. Looking inside this folder you will see four files:

Points	This is a binary file containing all point elevations
Index	This binary file guides LidarViewer through the much larger Points file
Normals	This contains normal vectors for each point for hillshading purposes
offset.txt	This file holds an offset between the external and internal coordinates.

You will treat the .lidar folder as if it were a single file. To open EMC_TLS.lidar, simply drag the folder on top of the icon for Lidarviewer-2.x application. This is what you should see:

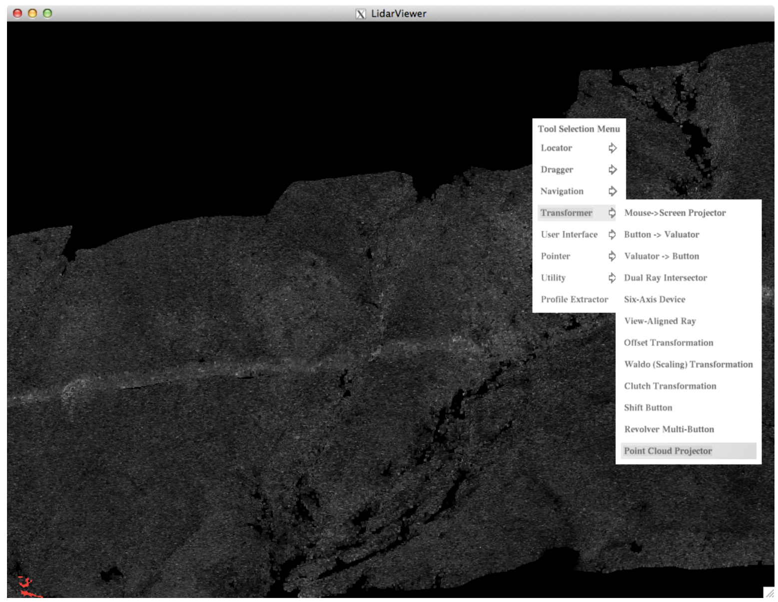


This is a view of a terrestrial lidar point cloud collected from the Borrego fault that ruptured during the 2010 El Mayor-Cucapah earthquake. This data set is described in Gold et al. (2013, EPSL) and is freely available from http://opentopography.org. The point color is the intensity of the lidar return. Click and drag in the window to rotate the data around the view point in the center of the screen. Use a scroll wheel or two-finger drag on the trackpad to zoom in and out around the view point.

PART 2: Assigning a Tool

LidarViewer (and all KeckCAVES software built on the VRUI platform) follows an unusual user-interface scheme. Users assign tools to buttons. For a desktop / laptop, most buttons are available. Traditionally the number keys, 1-9 are used. The first tool we will assign is to re-center the view point underneath the cursor. This allows you to navigate precisely around the data. Because we are using a 2-D interface to look at 3-D data, tool assignment is a two step process:

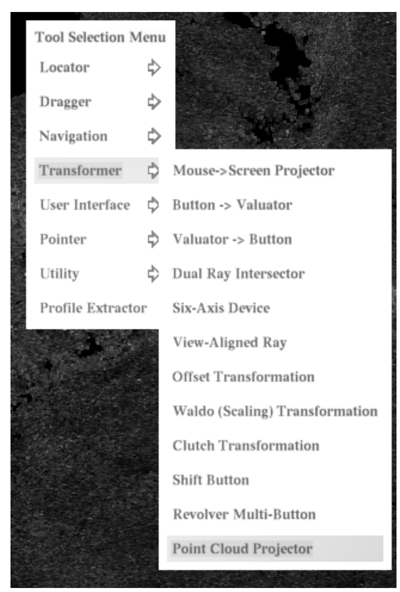
Step 1. Assign a 'point-cloud projector' to the 1 key. This tells LidarViewer that the tool assigned next to the 1 key will act on the point directly underneath the cursor, projected from your point of view.



Press and hold the 1 key. A menu will appear on the screen. ***Move the cursor while holding down the 1 key!*** **Hover, but do not click** 'Transformer' and then hover over 'Point Cloud Projector.' ***Let go of the 1 key while hovering over 'Point Cloud Projector.'*** The act of letting go of the key assigns it to have the 'Point Cloud Projector' property.

If successful, you will see a 'tool tip' screen that looks like the screen below. Press the 1 key again to remove this screen.

Step 2. Assign a 'Warp to Position' to the 1 key. Just as before, **Press and hold the 1 key**. A menu will appear on the screen. ***Move the cursor while holding down the 1 key!*** **Hover, but do not click** 'Navigation and then hover over 'Warp to Position' ***Let go of the 1 key while hovering over 'Warp to Position.'***



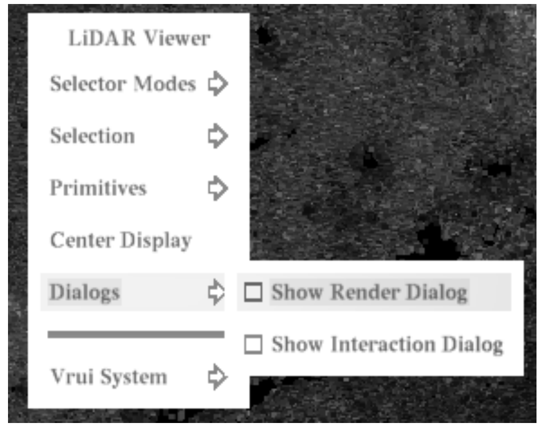
If successful, then you have now assigned the 1 key to re-center the data under the cursor. Give it a try and explore the data in detail.

If for some reason the key got assigned to the wrong tool, you can reset the tool by hovering over the red box in the lower left corner of the screen and pressing the 1 key. This will reset the key.

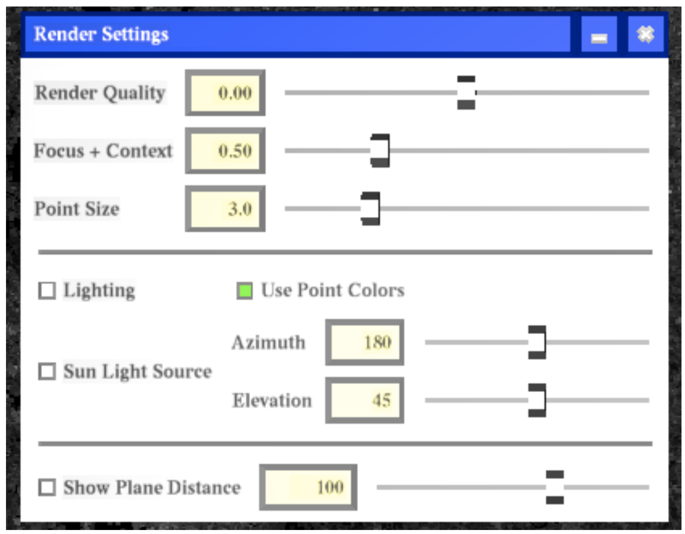
Do not click on the red box with the mouse button. This will disable the mouse button and you will be forced to restart LidarViewer.

PART 3: Hillshade Visualization

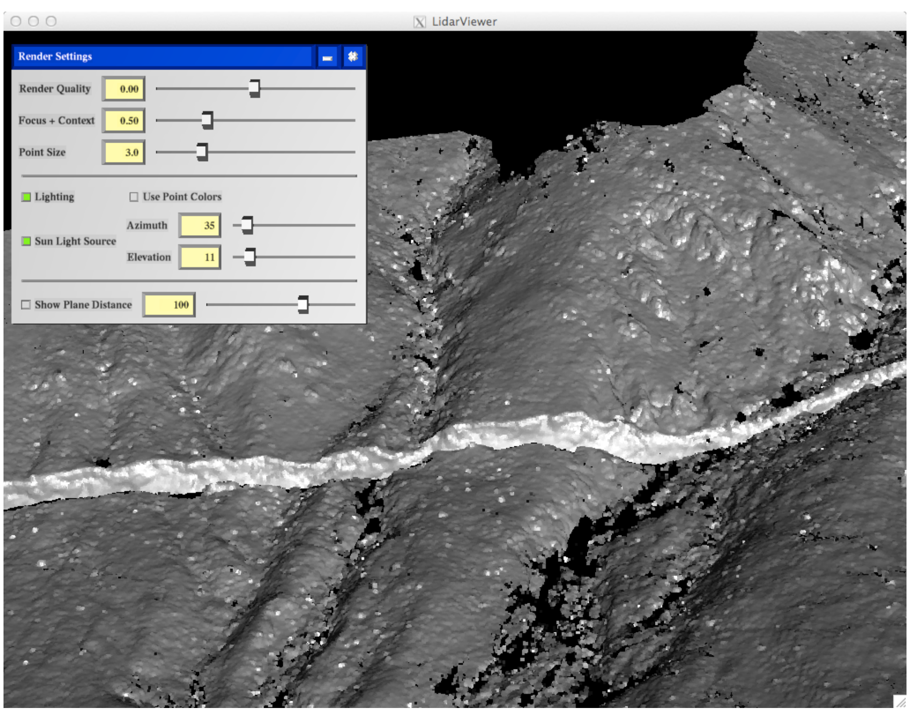
LidarViewer provides dynamic hillshading. This uses normal vectors computed for each point to drive a graphics-card based shader. The sun position can be varied in real time, and it is also possible to blend point intensity with the hillshade. Hillshading is available from the 'Render Dialog' menu. This is available from a special auxiliary 'LIDAR Viewer' menu obtained by right-clicking (cmd-click or two-finger click without a two-button mouse):



There is no need to click on 'Show Render Dialog.' Just let go of the mouse button on the menu. The menu shows several options:



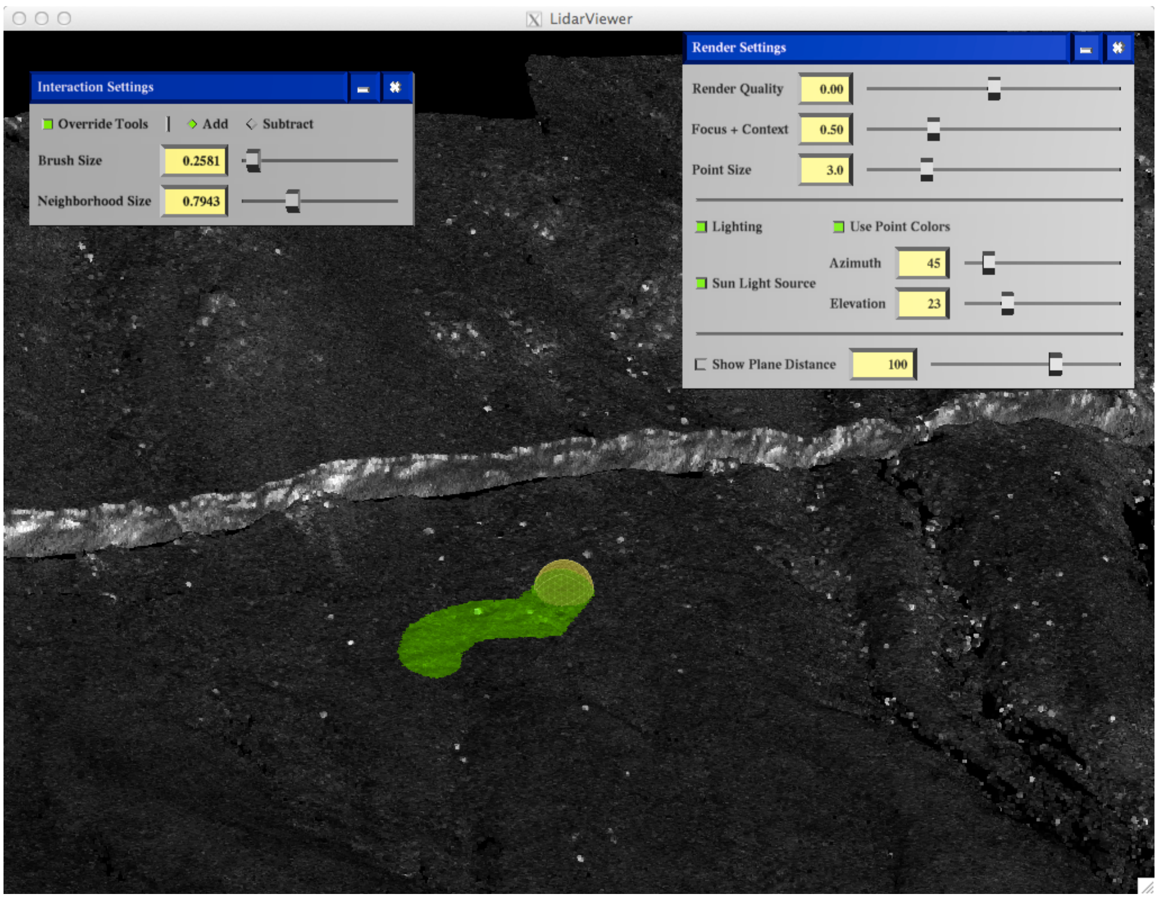
To visualize the lidar point-cloud in hillshade mode, switch on the 'Lighting' button and then switch off the 'Use Point Colors'. In this mode the data is illuminated as if the user has a flashlight on their head. To move the light source, click on 'Sun Light Source' and move the 'Azimuth and 'Elevation' sliders. Note that the menus will sometimes turn dark. This is a bug in LidarViewer – move the data around to re-arrange the perspective on the menu. Below is an example of the data with hillshading.



PART 4: Selection of Data

Interactive data selection directly from the point cloud is one of the powerful features of LidarViewer. It works with a 'Selection Brush' tool that we will assign to the 2 key in the same manner as the 'Warp to Position' tool was assigned to the 1 key. **It is important to first assign a 'Point Cloud Projector' to the 2 key.** Next, hold the 2 key down again and go to 'Locator,' then hover over '6-DOF Locator' and let go of the 2 key. If done correctly, you should see a yellow transparent ball on top of the point cloud.

There is a useful menu, called the 'Interaction Dialog,' that will help you with data selection, such as changing the brush size. Bring this menu up the same way you got the 'Render Dialog' – by using the auxiliary (right-click) menu and selecting 'Dialogs' -> 'Show Interaction Dialog.'



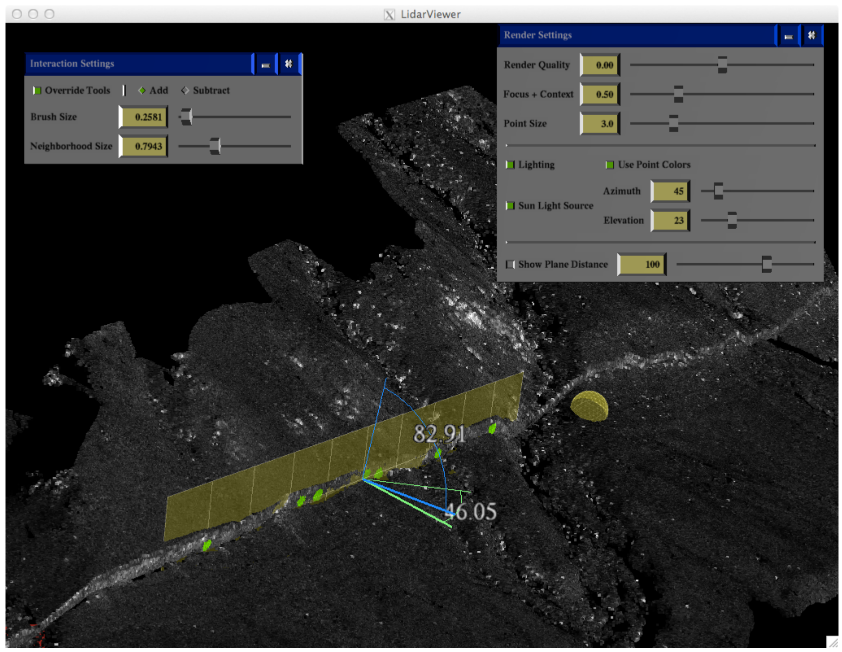
IMPORTANT: Selected data (shown in green, above) is not visible unless the point colors are turned on. This is an important reason to use the blended 'Use Point Colors' option on the 'Render Settings.'

To select data, press and hold the 2 key while moving the cursor over the data. You should see a trail of green selected points, as shown in the example above.

To export selected data, use the Auxiliary Menu->Selection->Save Selection. This will generate a text file called SelectedPoints.xyzuvwrgb. ***Due to the way that the pre-compiled LidarViewer binary works, this file is saved inside of the application. To find the file, right click or cmd-click the application and select 'show package contents.'***

PART 5: Strike and Dip (Fitting Primitive Shapes)
LidarViewer contains some basic analysis tools for fitting geometric primitives to selected point returns. You will use this functionality to measure the strike and dip of the Borrego fault. ***First, clear any previous data selection: Auxiliary Menu->Selection->Clear Selection.*** Next, select some data on the exposed, nearly vertical plane of the Borrego fault. Selecting patches of data along the fault works best. Once done, select Auxillary Menu->Primitives->Indicate Strike and Dip. If done correctly the result should look something like this:

Example of a strike and dip calculation for the Borrego fault. The green patches are selected data along the fault, and the yellow plane is the best-fit to these data. The blue angle is the dip, of 82.91°. The green angle is the dip direction, which is to the northeast (046.05°). Note that though the function is called 'Strike and Dip' the dip direction is 90° clockwise from the strike direction!



To remove the plane visualization, use Auxilary Menu->Primitves->Clear Primitives.

PART 6: Measurement
Lidarviewer, and all VRUI software, allows users to make measurements directly within the 3D environment. The measurement tool is set up the same way as the other tools. First set up a point cloud projector on the 3 key. Then set up the measurement tool by holding down the 3 key again and selecting Utility->Measurement Tool. The measurement tool offers three modes: Position, Distance, and Angle. Position gives the XYZ position of a selected point, while Distance measures the distance between two selected points. The measurement tool also offers three coordinate systems: Physical, Navigational, and User. User is the same as map coordinates.

Example measure of the height of Borrego fault scarp. Distance between top and bottom of the scarp is 2 meters.