# A Tutorial for 3D Point Cloud Editor

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**Abstract**

This tutorial illustrates the uses of the point cloud editor with examples.

## 1 Introduction

The point cloud editor supports features on cloud visualization and editing. The visualization functionalities include:

- Formats supported: `.xyz` and `.las`.
- Cloud rotation: rotate the cloud alone the X, Y or Z-axis.
- Cloud moving: move the cloud to the left/right/up/down of the camera.
- Zooming in and out.
- Adjusting point rendering size.

The functionalities of cloud editing include:

- Point selection by mouse clicking, 2D rubber band, and 3D cube. Each has an undo facility.
- Invert selection.
- Point deletion, cutting, copying and pasting.
- Point moving with different speeds and moving undo.

All the features above can be achieved with mouse operations and the buttons in the tool bar:


## 2 Visualization

We show how to use the visualization features in this section.

### 2.1 Loading point cloud

One needs to load the cloud file before editing or visualization. To load a cloud file, select the "open" in the menu of the editor, or click the file open button in the tool bar. A short-cut is to press "command + o" in MacOS or "ctrl + o" in Windows/Linux. Note that, `.las` support is still experimental and subject to the power of liblas. The current supported LAS versions are 1.1 and 1.2..

## 2.2 Saving point cloud

The edited point clouds are saved as a `.xyz` file by selecting the "save as" in the menu, or click the save button in the tool bar. A short-cut is to press "command + s" in MacOS or "ctrl + s" in Windows/Linux.

The other option is to save clouds in `.las` format by selecting the "save as .las" in the menu. A short-cut is to press "command + w" in MacOS or "ctrl + w" in Windows/Linux. Note that the .las file written by the 3D point cloud editor follows LAS 1.2 and Point Data Format 3. We decided to treat every .las file to be written as a new piece of data. The fields in the .las header which are automatically filled by our the cloud editor are: *file creation day of year*, *file creation year*, *number of point records*, *scale factors*, *offsets*, as well as *maximal and minimal coordinates*.

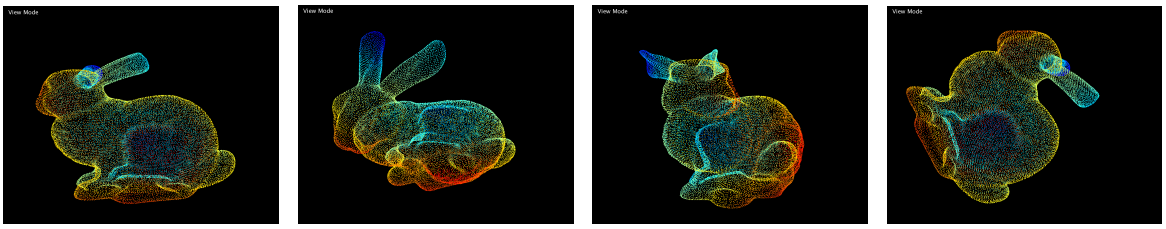
## 2.3 Rotation

**Rotate by x-axis** Keep pressing down the left mouse button while move the mouse up or down.

**Rotate by y-axis** Keep pressing down the left mouse button while move the mouse to the left or right.

**Rotate by z-axis** Rotate by z-axis: keep pressing down the right mouse button while move the mouse to the left or right.

Figure 1 shows an example for each rotation.



(a) Initial position (b) By x-axis (c) By y-axis (d) By z-axis

Figure 1: Examples of point cloud rotations.

## 2.4 Moving camera

**Move by x-axis** Hit the left or right key. Or you can use the left and right arrow buttons on the tool bar.

**Move by y-axis** Hit the up or down key. Or you can use the left and right arrow buttons on the tool bar

## 2.5 Reset camera

Press "r" key in the view mode.

## 2.6 Zooming

**Zoom in** Hit the home key. Or just click the zoomin button in the tool bar.

**Zoom out** Hit the end key. Or just click the zoomout button in the tool bar.

### 2.7 Point size adjustment

**Increase point size** hold shift-key and press "+" key.

**Decrease point size** just press "-" key.

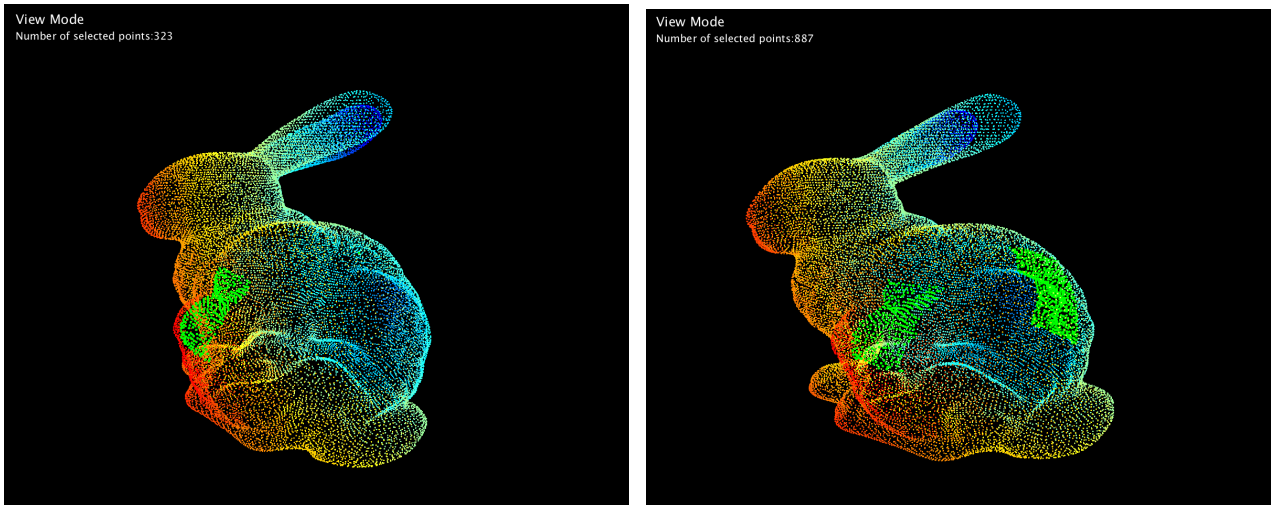
An alternative way is to use the point size spinbox Point Size: 3 on the tool bar to select your favorite size.

## 3 Cloud editing

We show how to use the editing features with examples.

### 3.1 Point selection

Selection mode needs to be activated first by pressing the "s" key or clicking the selection button . Two sub-modes are supported in the selection mode. As shown in Figure 5, the shallow mode selects the points only in the front. The deep mode selects every points under the rubber band or mouse pointer. Switch between these two sub-modes can be done by hitting "q" key in selection mode. After finishing selection, you are suppose to switch back to view mode by pressing the "s" key or clicking the selection button again. Note that the default selection mode is set to deep selection.



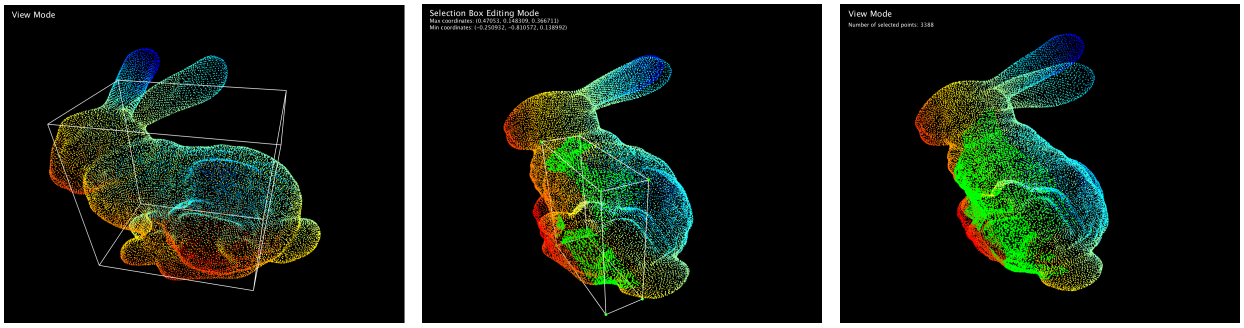

(a) Shallow selection (b) Deep selection

Figure 2: Comparison between shallow and deep selections. Shallow selection only selects points in the front.

**Selection by picking** Just left click the points you want to select.

**Using rubber band** Press the left mouse button at the starting point of the rubber band. Drag the rubber band, keeping the left mouse button pressed. Release the mouse button at the finishing point of the rubber band. The points which are selected will be displayed using green color.

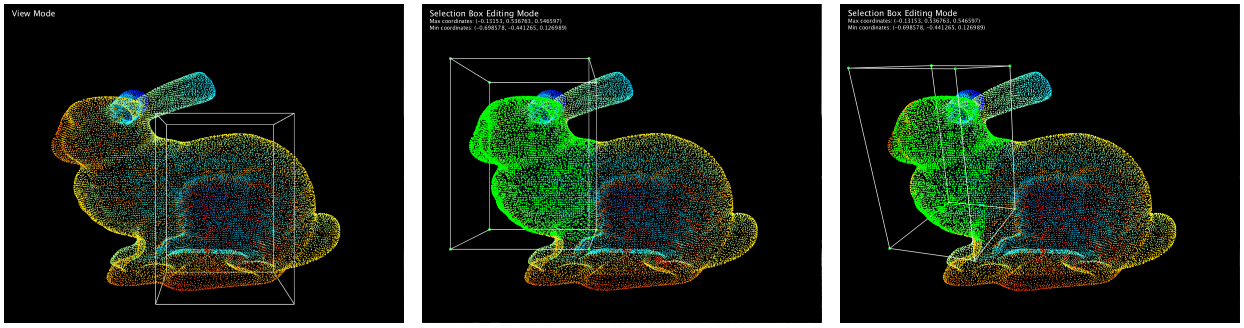
**Selection using 3D cube** Press the "g" key to activate this mode or press the button  . Then start drawing the box. The drawing motion is the same as the one for drawing a 2D rubber band. The drawing results in a 2D frame. Then we press "g" key or press the button  to deactivate the drawing mode, and further press "e" key to enter box editing mode.




(a) After drawing the 3D selection cube (b) Editing the 3D selection cube (c) After confirming selection

Figure 3: Comparison between shallow and deep selections. Shallow selection only selects points in the front.

In the cube editing mode we can see the corners of the frame are highlighted with green color. To make a 3D cube, one just drag one corner apart from the others. Besides dragging the box corners, the editing mode also allows to drag the edges to move the whole selection box and to rotate the 3D cube by keeping pressing the right mouse button and moving your mouse at the same time. When the position of the box




(a) The original position of the 3D cube (b) After moving the cube (c) After further rotating the cube

Figure 4: Moving and rotating the 3D cube.

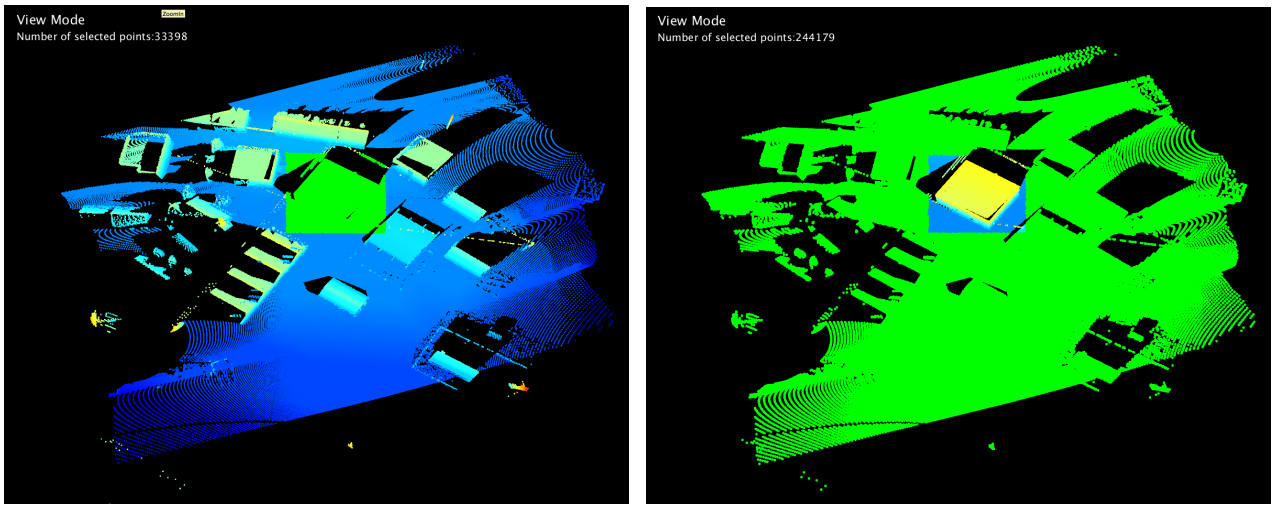
has been adjusted to your favorite position, press key "k" to confirm your selection. The selected points will be highlighted and put into the selection buffer.

**Deselection** If you want to cancel the selection of one point, just click that point again. If you want to cancel all the selected points, hit the escape key. Once a point is deselected, it will no longer be highlighted, and turn back to red.

## 3.2 Invert selection

By invert selection we mean to compute the complement set of the current selected points. To use this feature, select a set of points in the selection mode, then click the invert selection button  . Then the

complement set will be highlighted as the current selected points. If invert selection is invoked when no point is currently being selected, the whole point cloud will be selected after invert selection.




(a) Selection (b) After invert selection

Figure 5: Selection and invert selection.

### 3.3 Deletion

In the view mode, after a set of points is selected, hit "d" key to remove all the selected points from the cloud. Or you can click the delete button ✖ in the tool bar.

### 3.4 Copying

In the view mode, after a set of points is selected, hit "c" key to copy all the selected points from the cloud. Internally, these points will be copied to a copy buffer. Or you can click the copy button in the tool bar.

### 3.5 Cutting

In the view mode, after a set of points is selected, hit "x" key to cut all the selected points from the cloud. Internally, these points will be copied to a copy buffer, and be removed from the current point cloud. Or you can click the cut button in the tool bar.

### 3.6 Pasting

In the view mode, after a set of points is copied or cut, hit "p" key to paste them into the current cloud. The points will be have the same coordinates as the source points do, plus the pasted points will be highlighted using the green color. Or you can click the paste button in the tool bar.

### 3.7 Moving

In the view mode, after a set of points is selected, hit "m" key to activate the move mode. Or you can click the move button in the tool bar. To deactivate move mode, hit "m" key again. In the move mode, first left click a position on the screen and start dragging the selected points to your desired direction. Move the selected points by moving your mouse with the desired direction. Note that, if you want to move your

points in z direction, you will need to switch to view mode, rotate the model, then switch back to move mode to move the points. Figure 6 shows an example where we move the ear of the bunny off its body. If you want to cancel this movement and let all the moved points go back to their original position, press

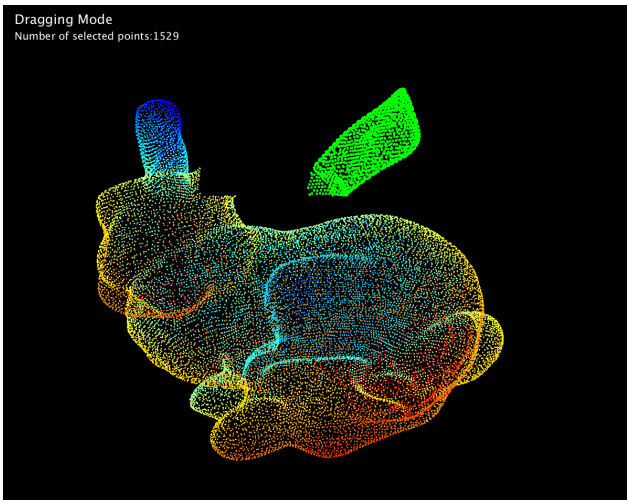



Figure 6: A move example.

escape key in move mode. The moving speed can be also chosen from the speed spinbox 

in the tool bar.

### 3.8 Undo

We also support undo feature for moving, pasting, cutting and deletion operations. The undo feature preserves the original order of the edited points in the cloud. In order to do so, we currently store the whole copy of the original point cloud in an undo stack. For instance, if a set of selected points are deleted from a cloud and an undo is invoked, the previous copy of the point cloud will be poped out of the undo stack to overwrite the deleted cloud. Note that this feature may cause memory issues if the point cloud being edited has large size and too many editing operations are performed. We currently have an undo depth limit set at 200. When the limit is achieved, everything in the bottom of the undo stack will be removed (therefore, the stack is actually implemented with a deque), and new command and cloud status are then pushed into the undo stack.