Introduction to Annotation GUI

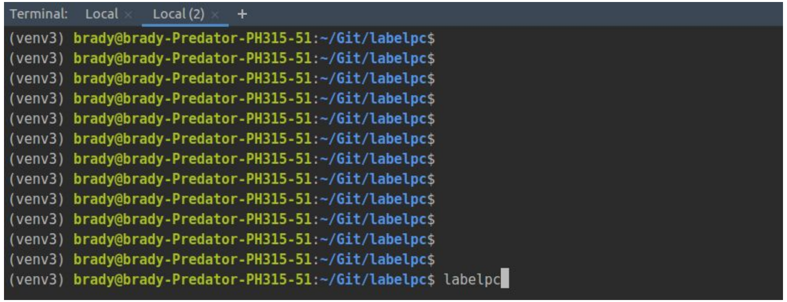
Annotation GUI for creating blueprints from
point cloud data in a semi-automated fashion

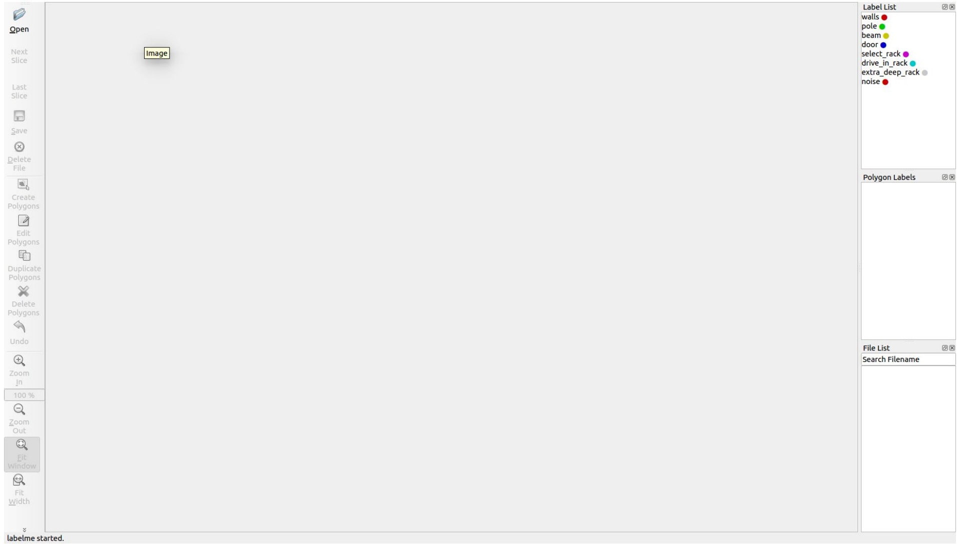
Slides by Brady Lowe (3/19/2020)
GUI developed by Brady Lowe and Austin Carey
Base code created by labelme team on Github

The annotation GUI is called “labelpc”, named after the original image GUI “labelme”.

It is called from command line by the command:

> labelpc

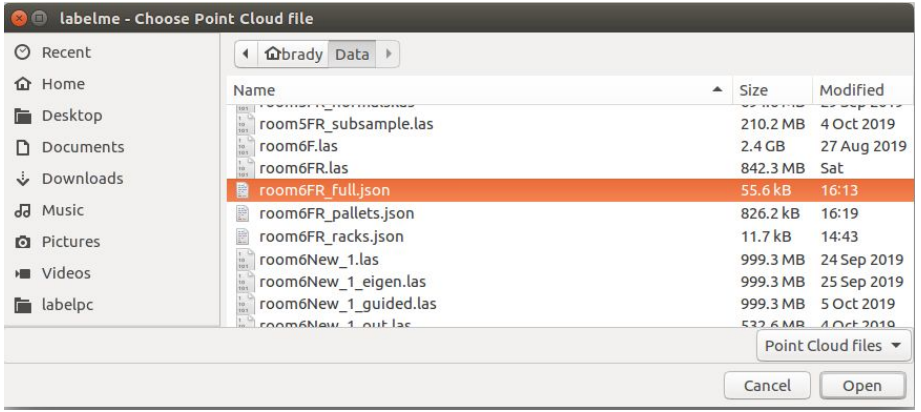




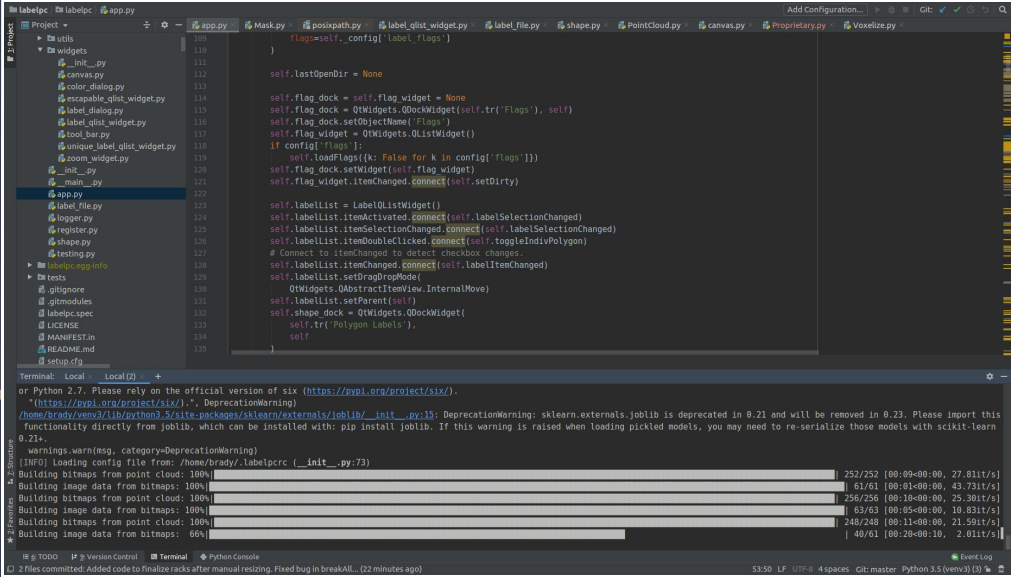
Once open, we can click the “Open” button or go to File->Open to open some point cloud data.

Many file formats are supported (.las, .laz, .pts, .ply, .pcd).

If there is an existing json annotation file that the user wants loaded, then that annotation file should be selected here.



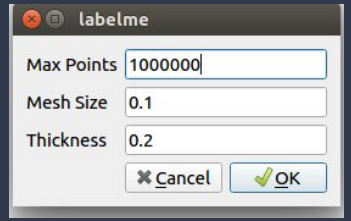
When loading the point cloud, progress bars are shown in the terminal, letting the user know about how long it will take to build the voxel grids from the point cloud as well as convert the information to image format.

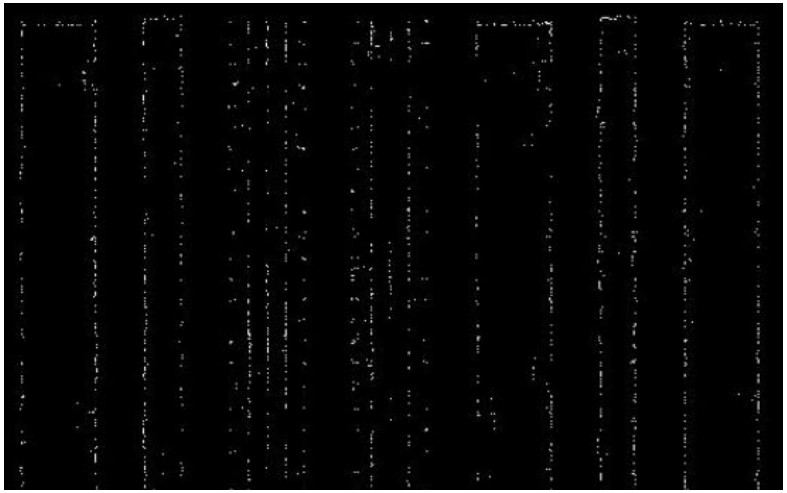


When a file is selected for opening, a dialog box pops up to ask how many of the points you would like to load (default 1 million) as well as what resolution you would like the point cloud to be rendered at.

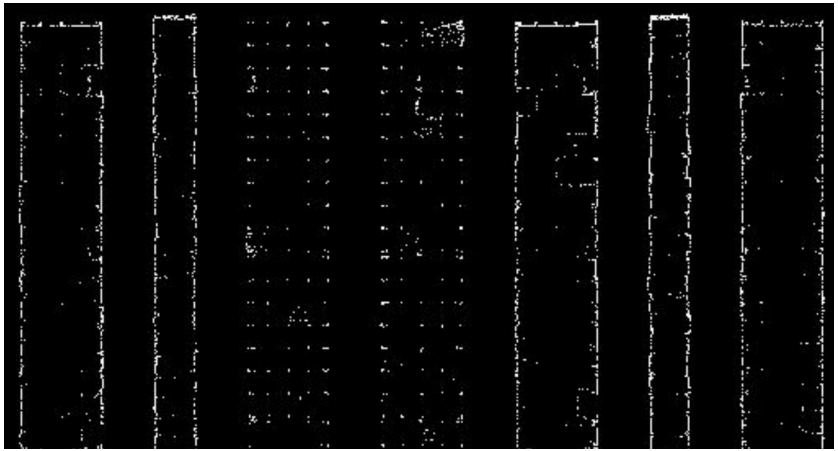
The default resolution of 10 cm x 10 cm shows the rack clearly and makes vertical support beams about 2 pixels x 2 pixels.

Default slice thickness is set at 20cm.



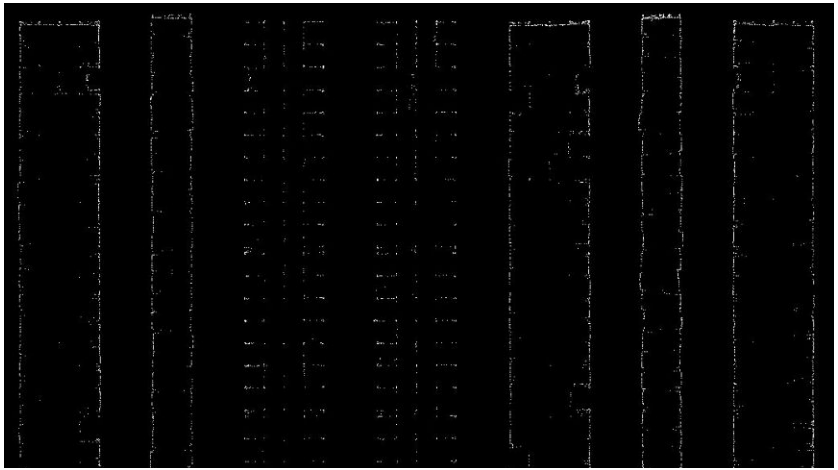


5 cm slice thickness

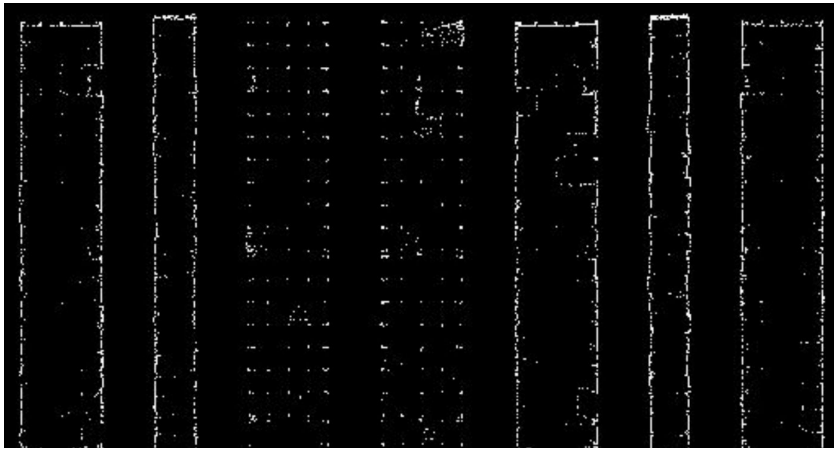


20 cm slice thickness

Resolutions smaller than 5cm x 5cm make the point cloud hard to see because there are many empty pixels.



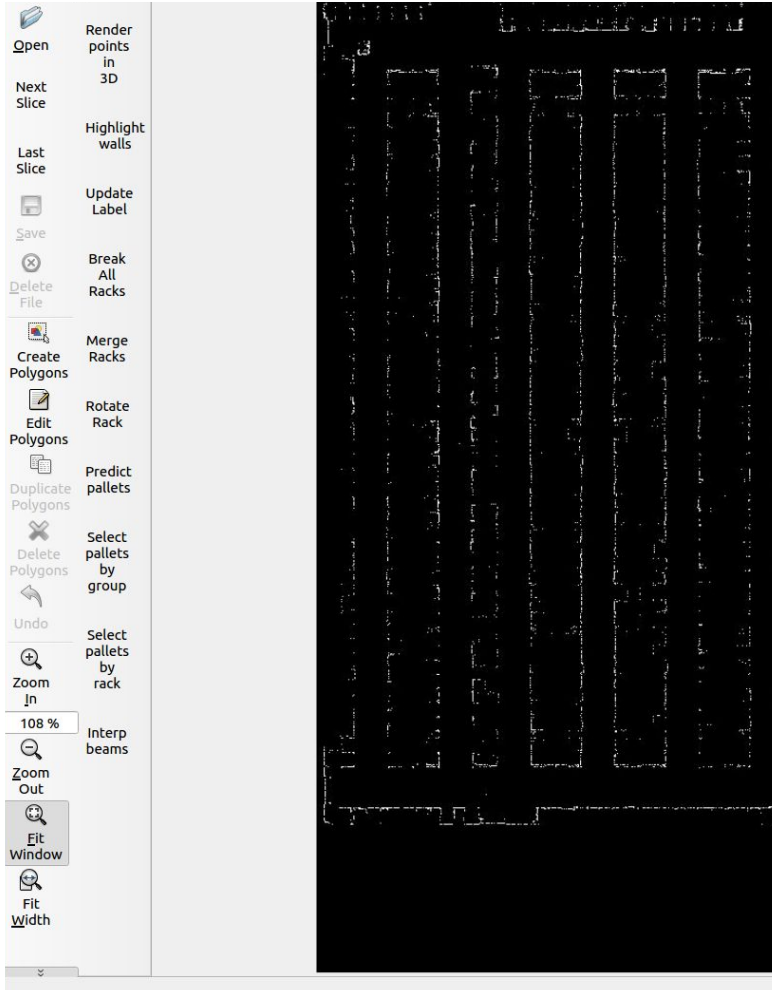
5 cm x 5 cm resolution



10 cm x 10 cm resolution

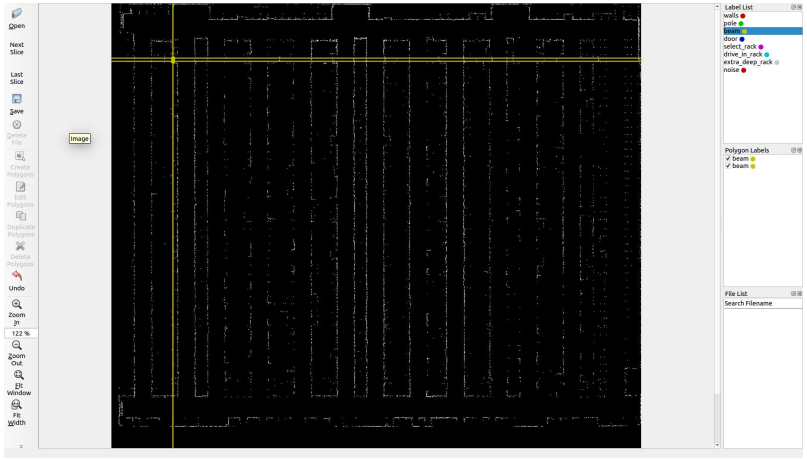
The toolbar on the left side of the screen gives access to much of the GUI's functionality including:

- Cycling up and down through the horizontal slices of points
- Zooming into and out of the point cloud
- Saving the annotations to file
- Editing and deleting existing annotations (polygons)
- Many tools to be discussed

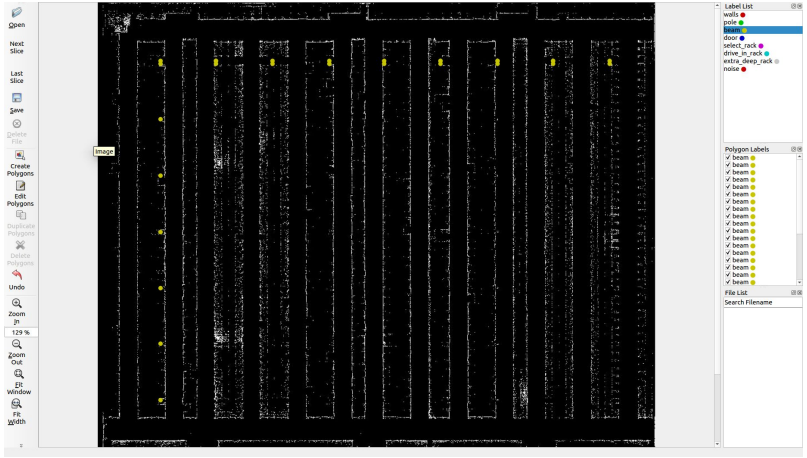


When annotating beams, we must find at least a few poles at first with no help, and then we can use the beam crosshairs to help us find more beams lying on these lines.

You can toggle the crosshairs on and off via the View menu (View->Show beam crosshairs).

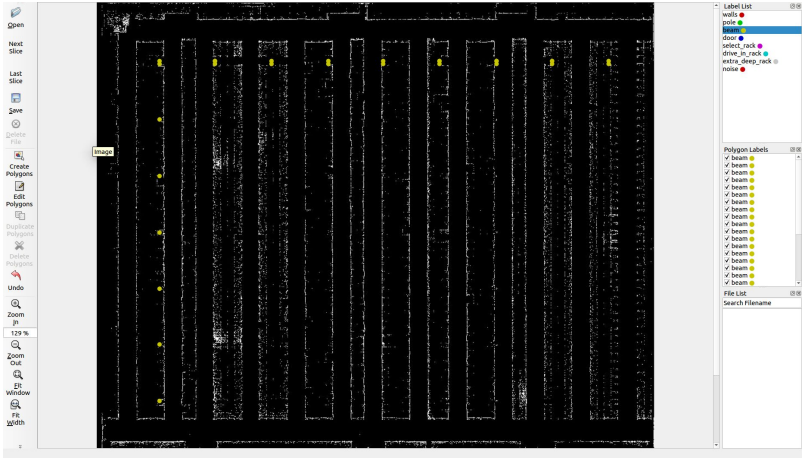


BEFORE

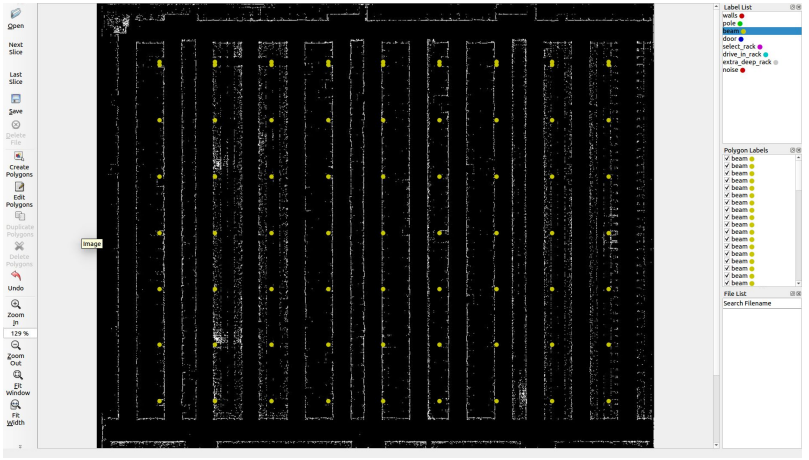


AFTER

Once we have all the beams annotated all the way up and down one column as well as all the way across one row, we can use the “Interp beams” button in the toolbar to automatically annotate the rest of the beams at crosshair intersections.



BEFORE

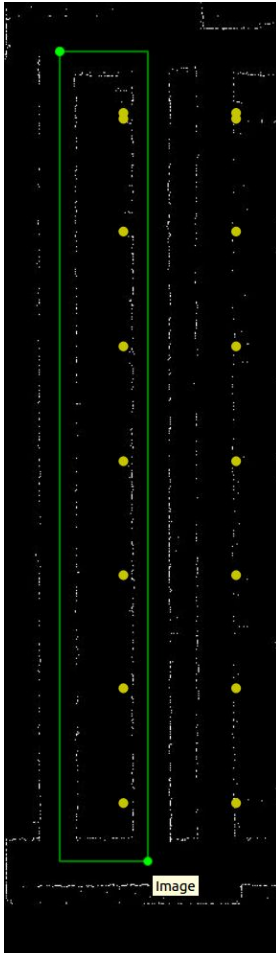


AFTER

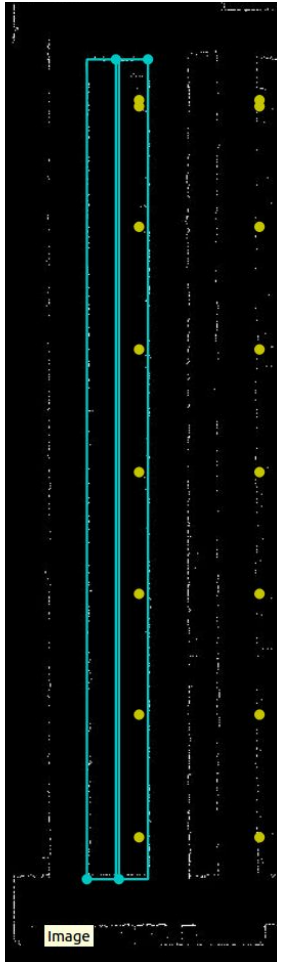
When annotating racks, the user can put a rectangle around two back-to-back racks or around a single rack. If the box surrounds back-to-back racks, that will automatically be detected and the box will be split in two.

The box will be tightened as well as possible to fit snugly around the rack points contained in the box.

Finally, the dimensions of the rack annotation will be adjusted to fit an integer number of pallet locations.



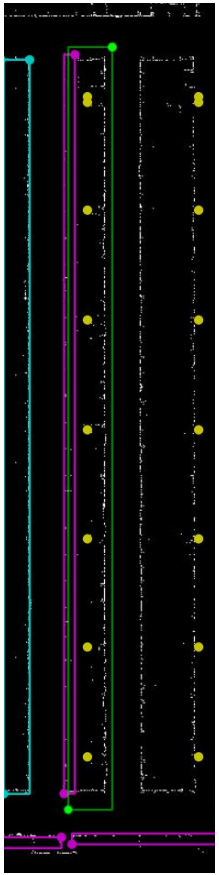
BEFORE



AFTER

Another automatic calculation happening upon rack annotation is checking for intersection with existing racks.

If a new rack annotation overlaps an existing rack, there will be an attempt to adjust the new rack annotation to remove the overlap.



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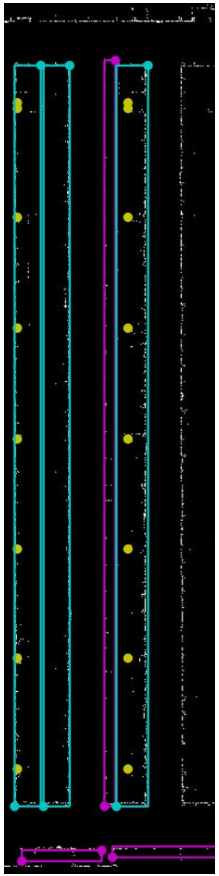
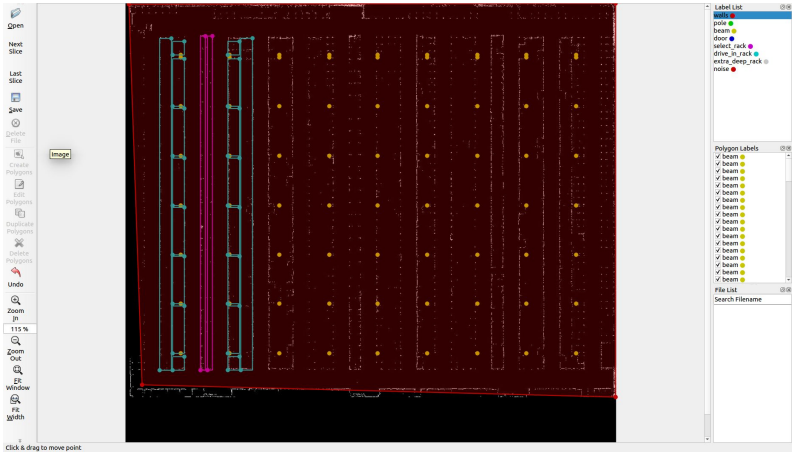


AFTER

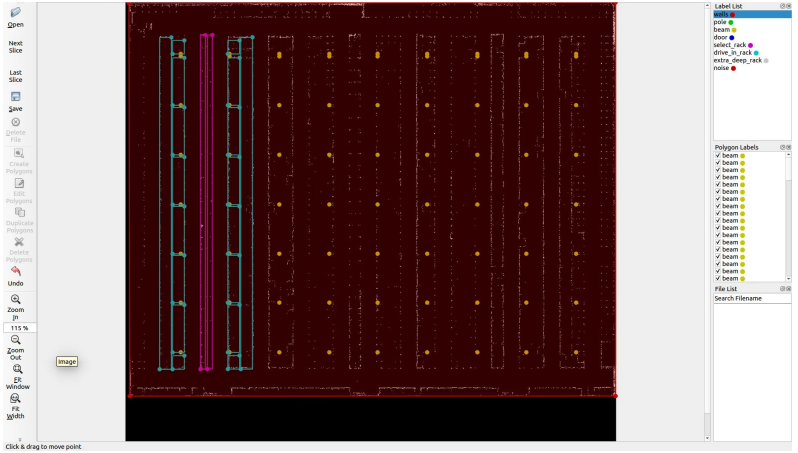
When annotating walls, the user will click on one corner at a time until completing the polygon (can double-click mouse anywhere on canvas to automatically close polygon).

The points will automatically be snapped to the corner locations. If the points are misplaced, the user needs to click on the “Edit Polygons” button and drag the vertex to the proper position.

Double-clicking on the walls label in the right menu will hide the walls.



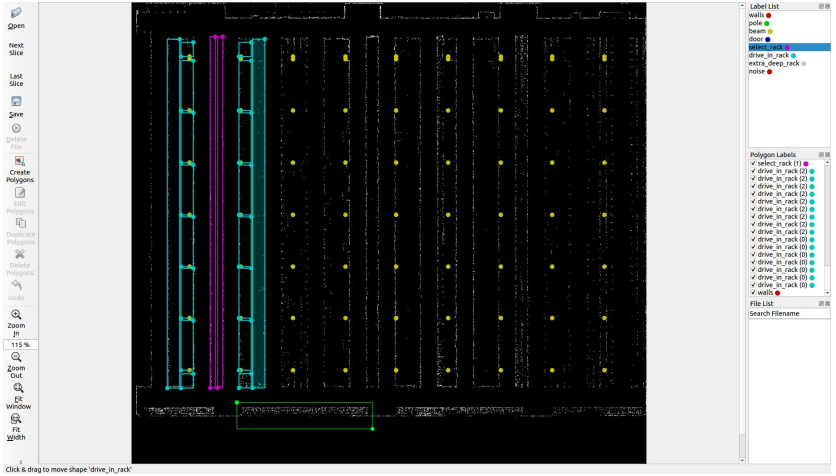
Bottom left corner misplaced



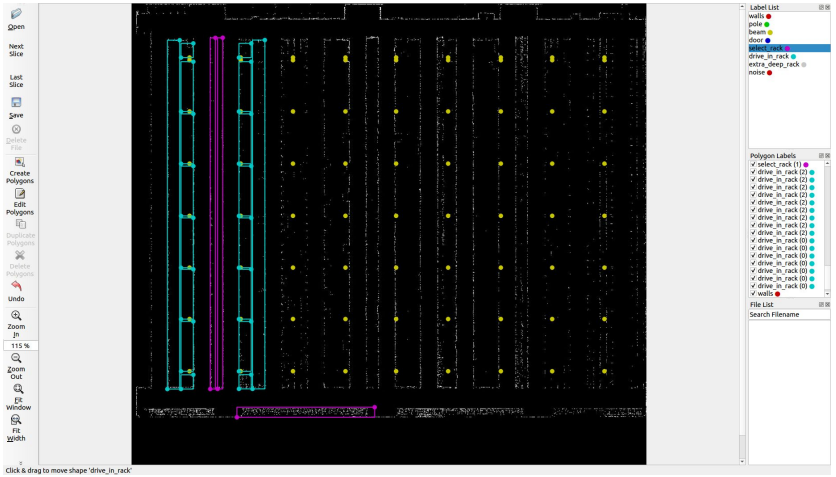
Bottom left corner correctly placed

After the walls have been annotated, any new rack annotations will check for overlap or collision with walls.

If the rack is determined to be in collision with a wall, there will be an attempt to resize the rack to fit completely within the walls as seen at the bottom of the images on the right.



Rack extending outside walls

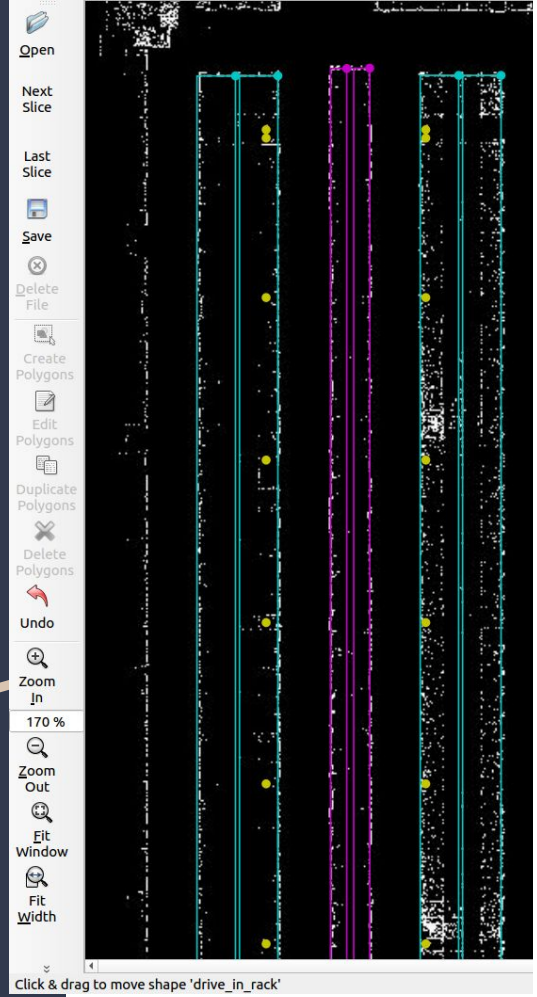


Rack resized to fit inside walls

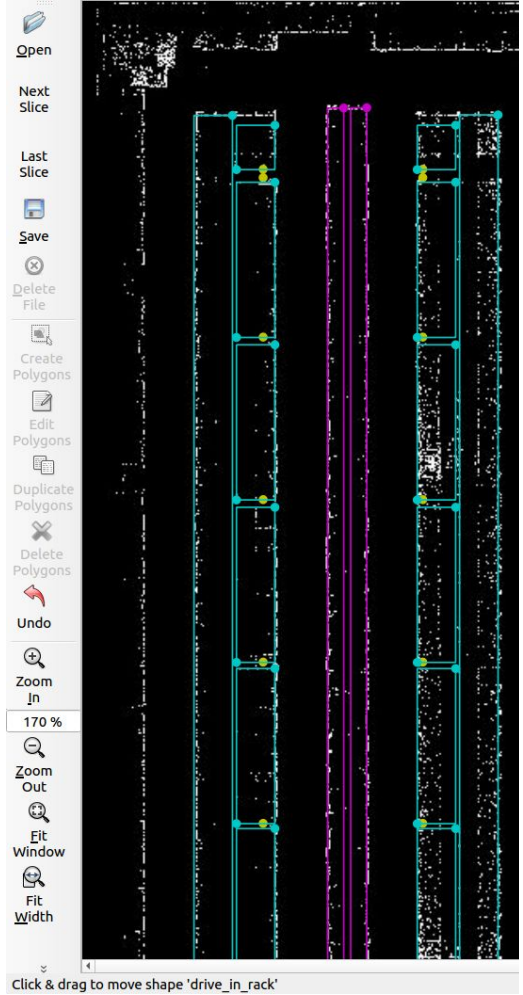
The “Break All Racks” button will loop over all the beams that have been annotated, and one by one it will check if that beam is breaking any rack. If so, the rack will be broken.

This allows the user to annotate beams before racks if this is desirable for any reason and still be able to break the racks later.

You can also break a rack manually by holding CTRL while right-clicking on the rack.



BEFORE



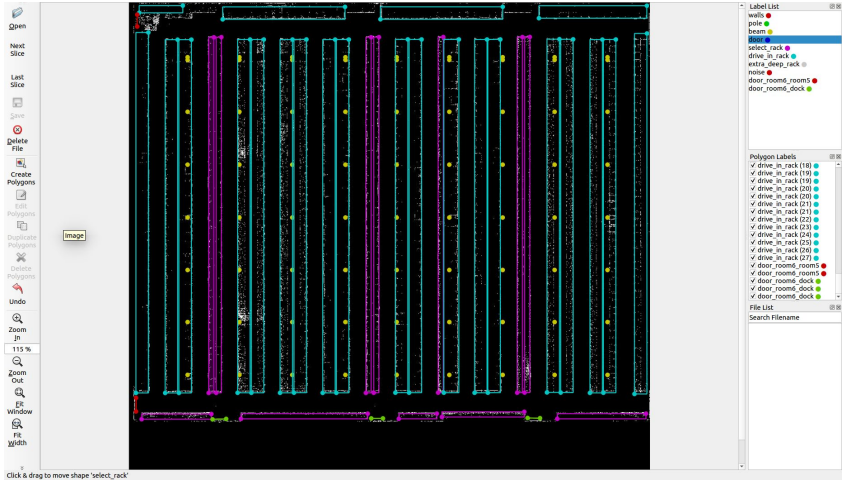
AFTER

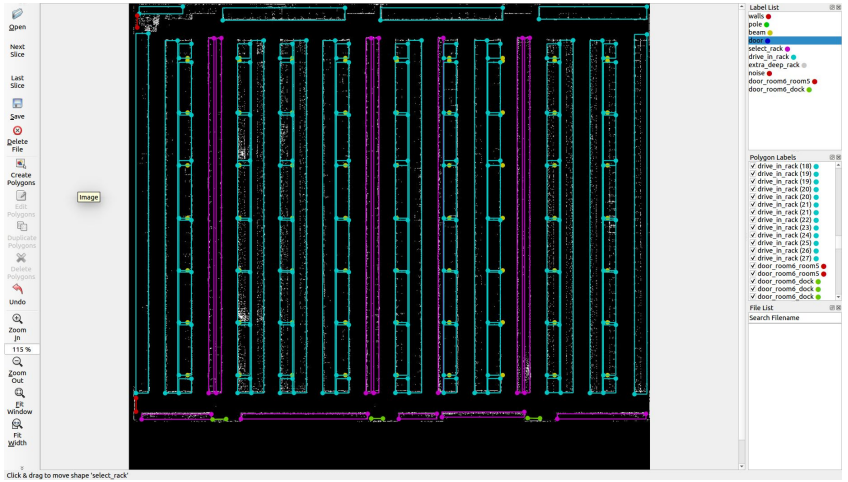
The image on top shows the racks and beams before calculating the breaks in the racks due to the beams.

The bottom image shows the racks after being broken by the beams.

Some more manual work needs to be done to help adjust the broken racks at this point.

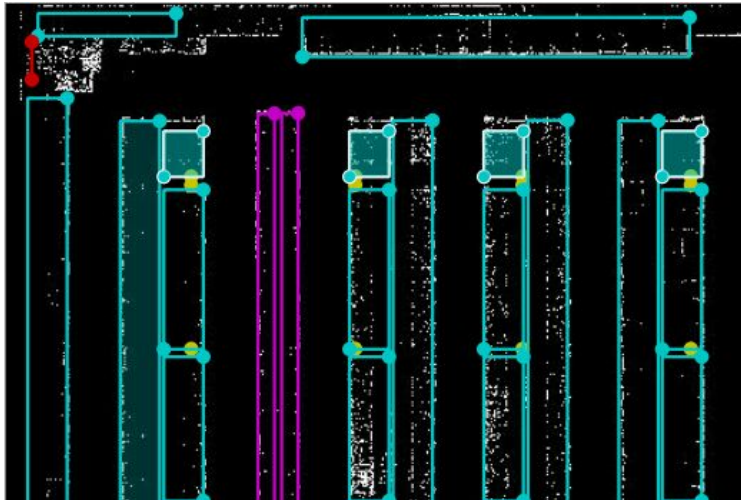
Note: the rack labels in the “polygon labels” list on the right show the Rack ID in parentheses.

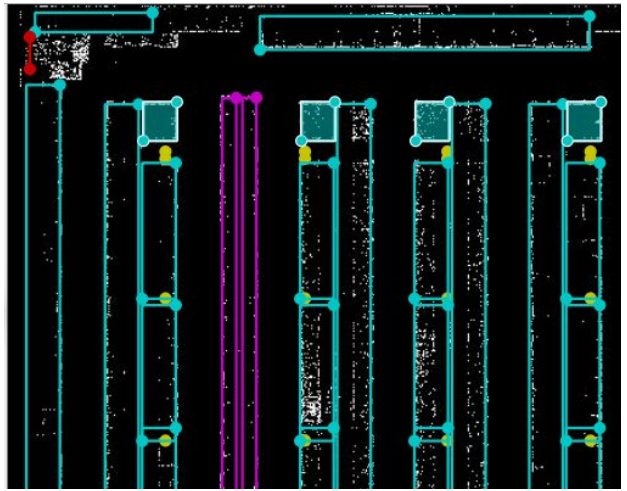




These images show the user moving several small racks into a better position.

The beams try to automatically split the racks and place them in the right position, but the user must manually adjust the position of some racks.

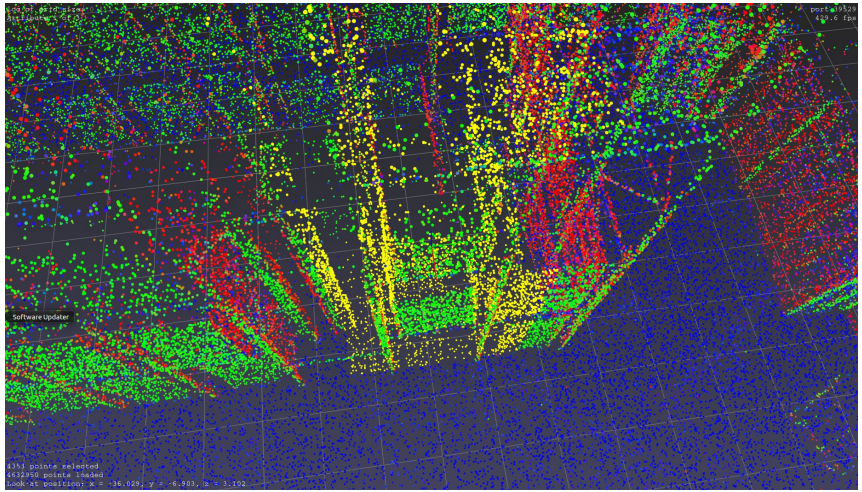


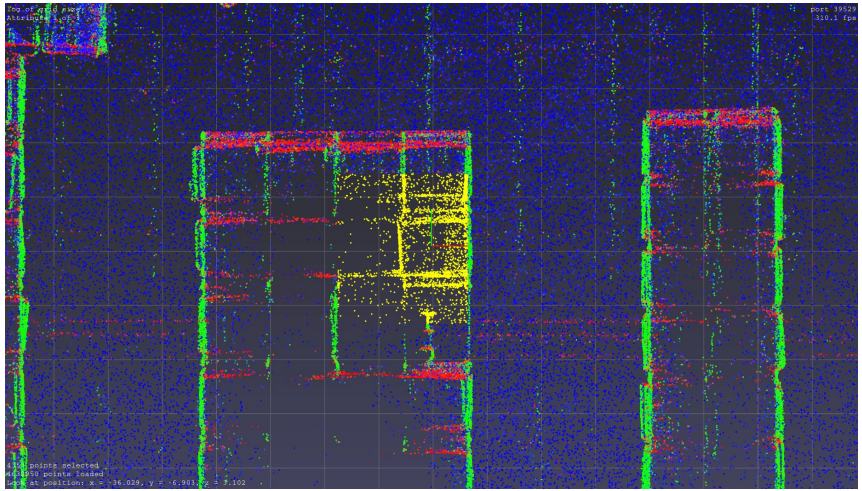


In order to check the positioning of the rack, you can open the points in a 3D viewer (View->Render points in 3D).

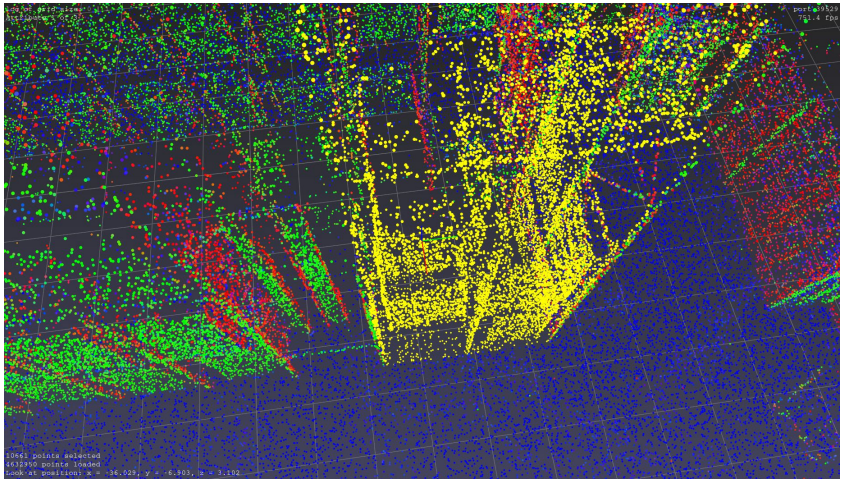
Once the 3D viewer is open, selecting an annotation will cause the corresponding points to be highlighted in the 3D viewer.

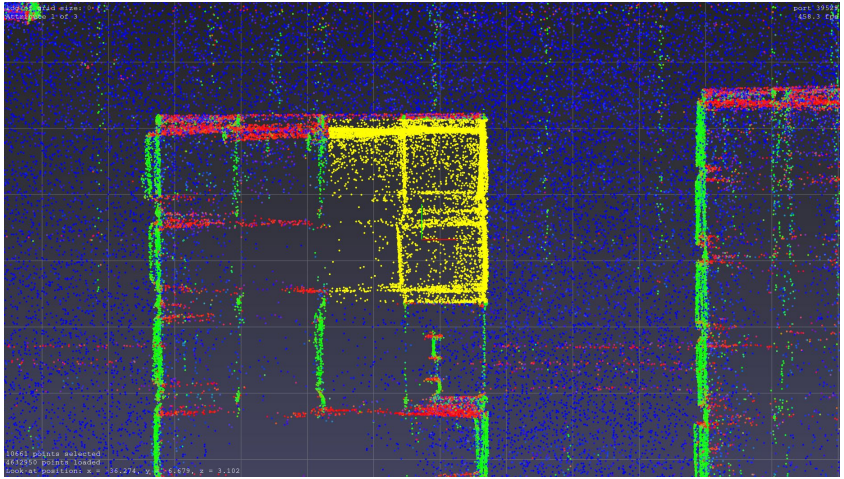
You can see that there are many points in the rack that are not highlighted that should be highlighted.





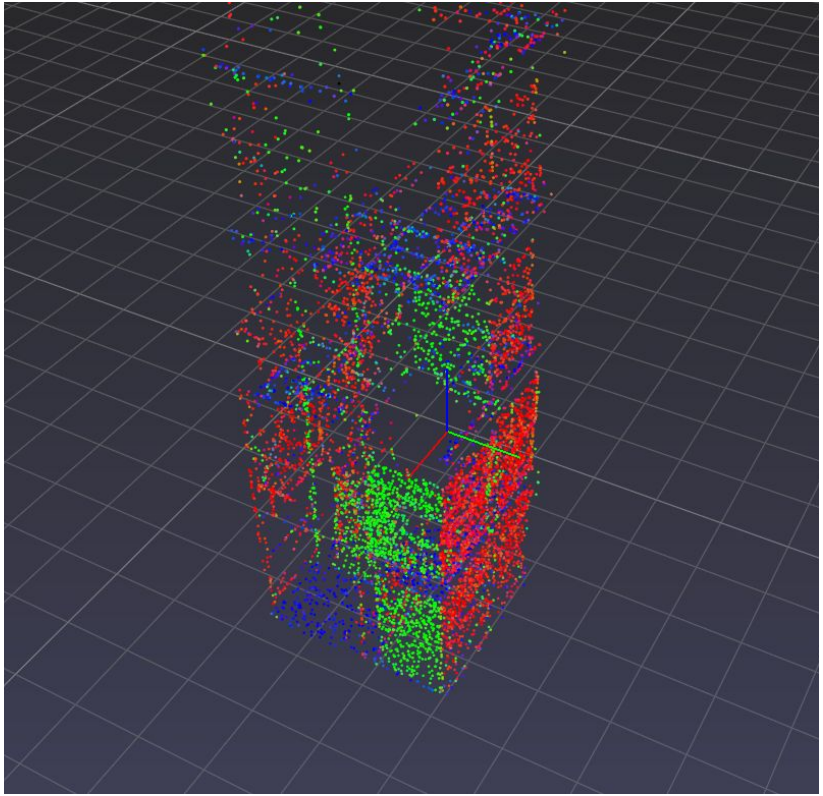
After moving the racks into proper alignment with the rack, we can select the points again and see that the correct points are now highlighted.





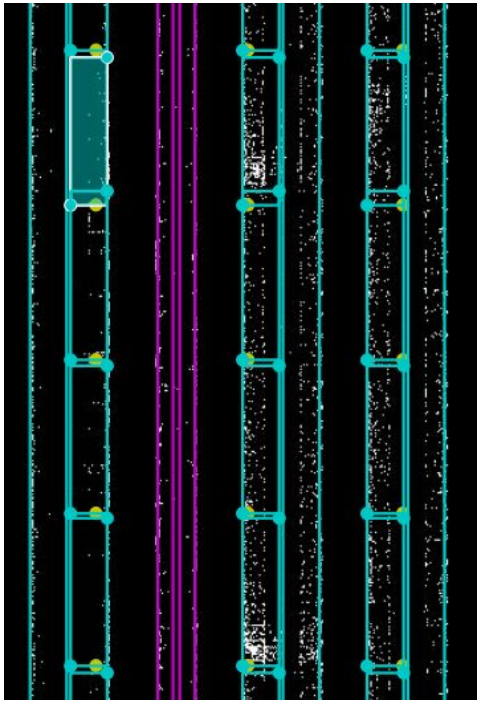
An alternative to simply viewing the highlighted points, the user can view ONLY the points contained in the annotation.

Select an annotation and then click View->View label 3D to render the points contained in the annotation.

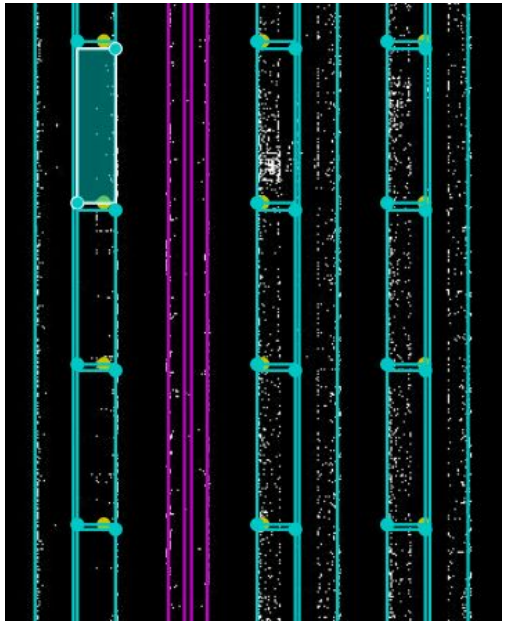


Another problem that occurs when the racks are broken by beams is that the resulting racks may be overlapping.

The user must correct this computational error by simply resizing the rack (drag and drop the vertex).



With overlap



Without overlap

Doors need to be annotated as well. They can be identified by scrolling up and down through the horizontal slices and looking for door frames.

The images show a succession of slices. The top image shows a slice containing the sides of the door frame. The middle image shows the top of the door frame. The bottom image shows a slice so high that it is completely above the door frame.

We need to name the doors in a consistent method. Use the convention that we list smaller numbers before bigger numbers and room names before dock names.

Examples:

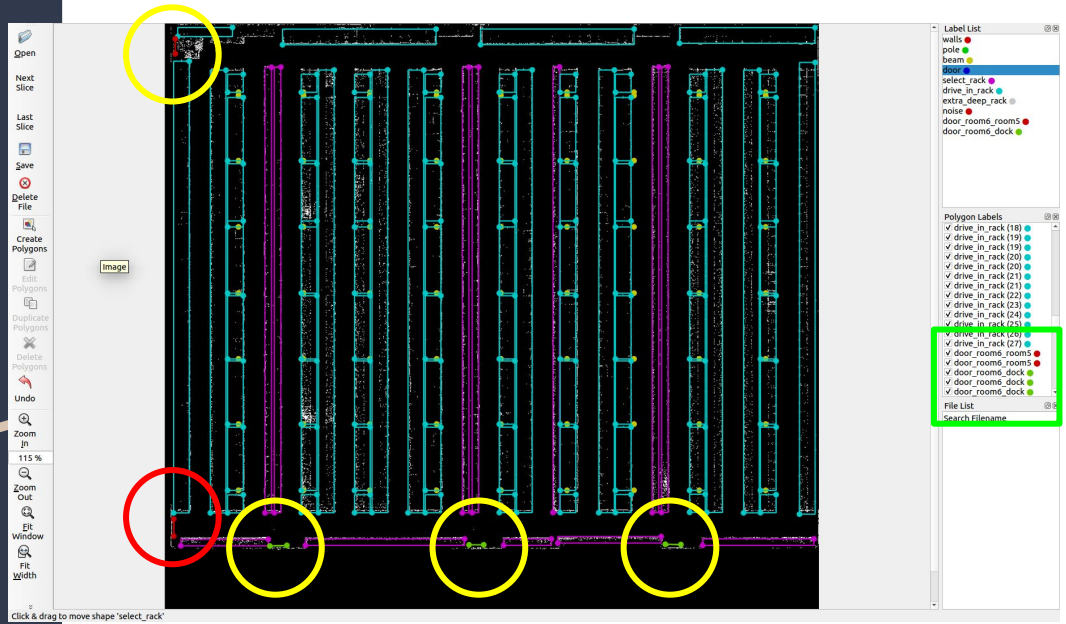
door_room5_room6 (correct)
door_room6_room5 (incorrect)

door_room6_dock (correct)
door_dock_room6 (incorrect)

The door seen in the previous slide is now annotated in the red circle shown here. This door is labeled “door_room6_room5” as seen in the Polygon Labels list at the right of the image in the green rectangle.

There are also other doors seen annotated in this image in the yellow circles.

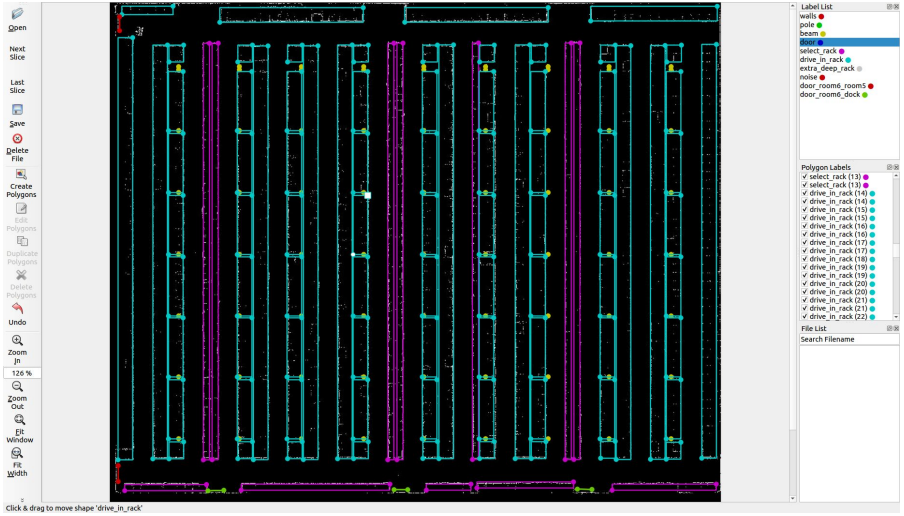
The doors leading to room 5 are labeled as such, as are the doors leading to the docking area.

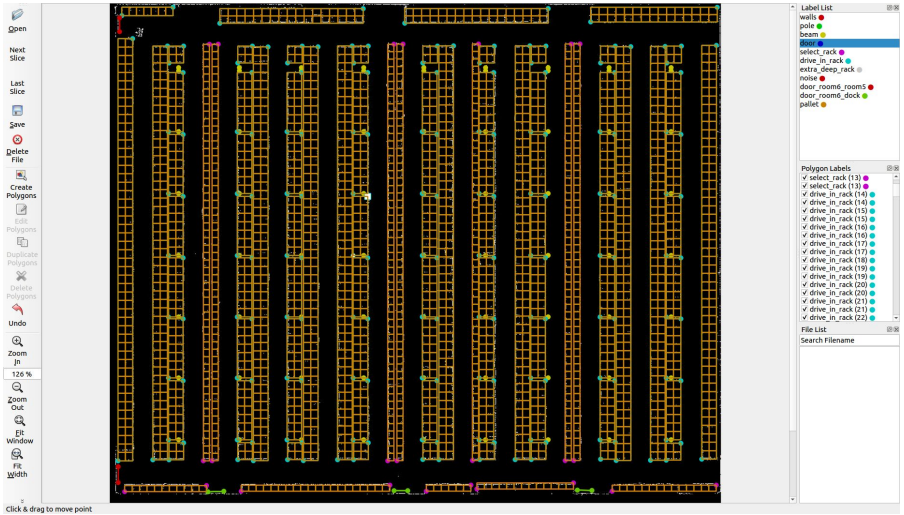


Once all the racks have been annotated, broken by beams, and finely positioned into their proper places, the pallet locations can be predicted.

Simply click on the “Predict pallets” button in the tool menu. This may take a minute or two to compute.

After filling the scene with pallet locations, the GUI will become heavily loaded and response will be slowed. This should be one of the last steps.

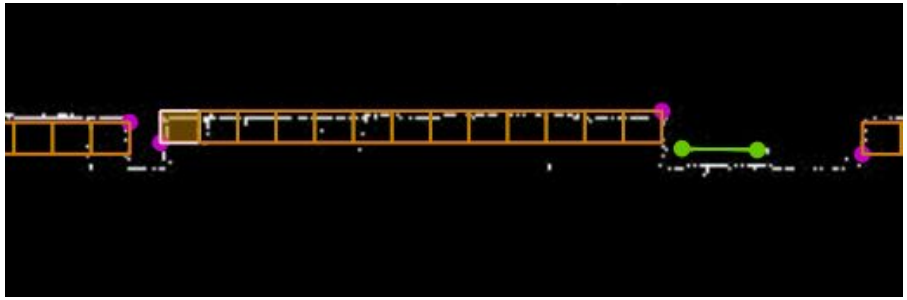


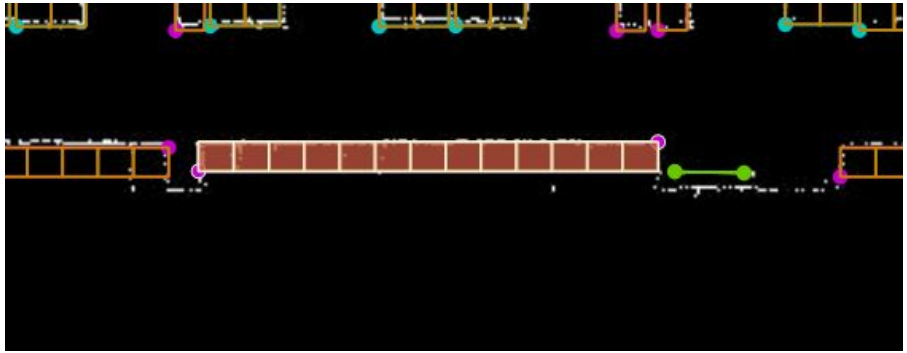


The “Select pallets by rack” and “Select pallets by group” buttons allow the user to select many pallets at once based on an already selected item.

First, select a rack or pallet, and then click one of the buttons. All the pallets sharing that rack or group ID will be selected. All these pallets can be moved together by holding CTRL button during drag and drop.

This functionality is also available in the context menu shown upon right-clicking on the canvas.

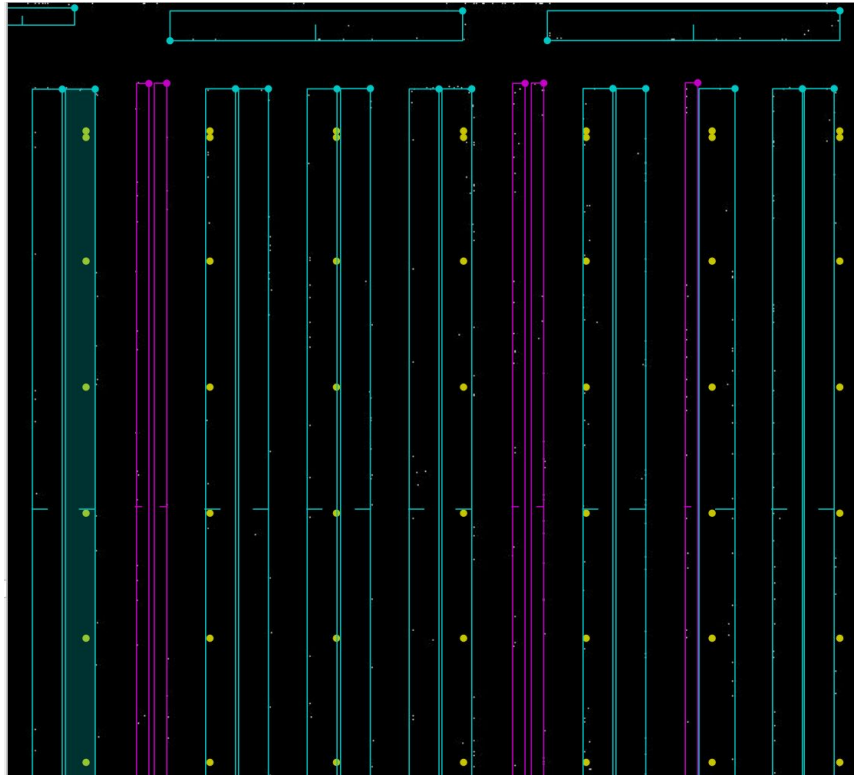




UPDATES

There are now orientation indicators shown in the racks. A line is drawn from the center of the rack to the outside of the rack, indicating the direction from which the pallet will enter the rack.

If the orientation is calculated incorrectly, you can select the rack and click the “r” key to rotate the orientation until it is correct.



Correct

Incorrect

I-Beams now have their own label category separate from “beams” which are the more-common square support beams.

The I-beams are shown in a different color, and they are shown as squares on the canvas rather than circles.