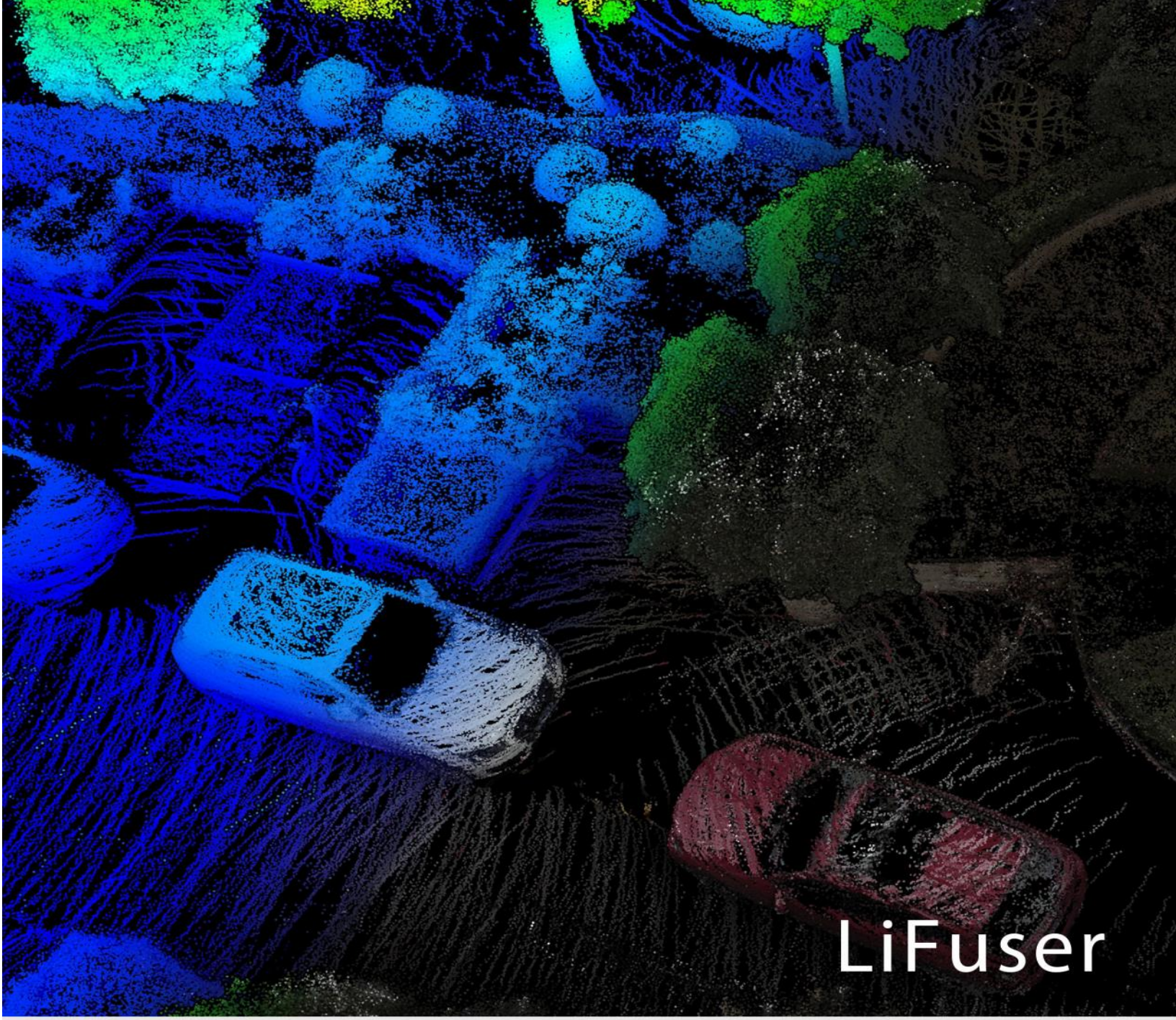


LiBackpack Data Fusion Software

User Guide

GreenValley International

GreenValley International Inc.

2120 University Ave. Ste. 210

Berkeley, CA. 94706

USA

+1 510 345 2899

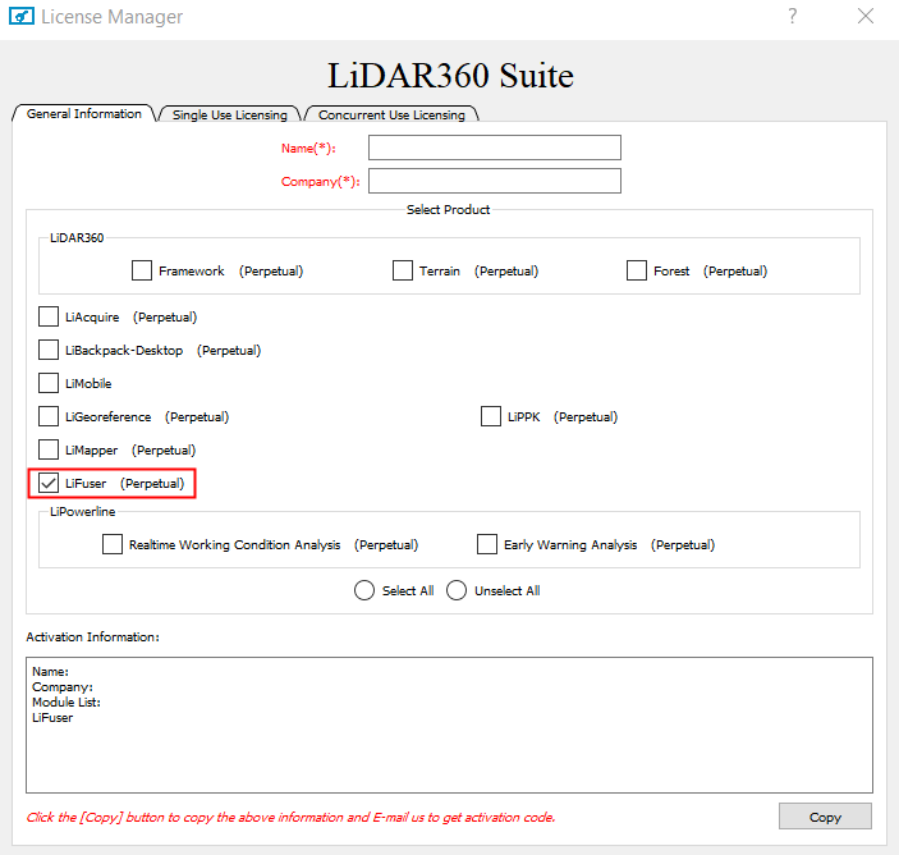
info@greenvalleyintl.com
www.GreenValleyInternational.com

Contents

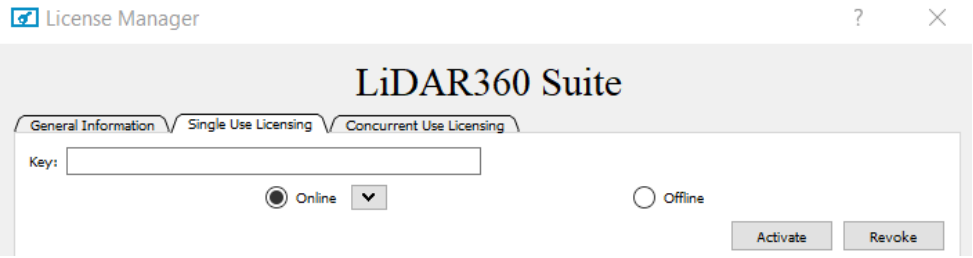
Licensing

For the full guide of licensing LiFuser, please visit LiDAR360 licensing. To license LiFuser using single floating license, please follow these steps:

1. In **License Manager**, under **General Information**, type in **Name, Company**, and check **LiFuser**. Click **Copy**, and email the copied information to info@greenvalleyintl.com.



2. After receiving the license key from GVI, under **Single Use Licensing** panel, enter the license key, and click **Activate** to activate the trial license.

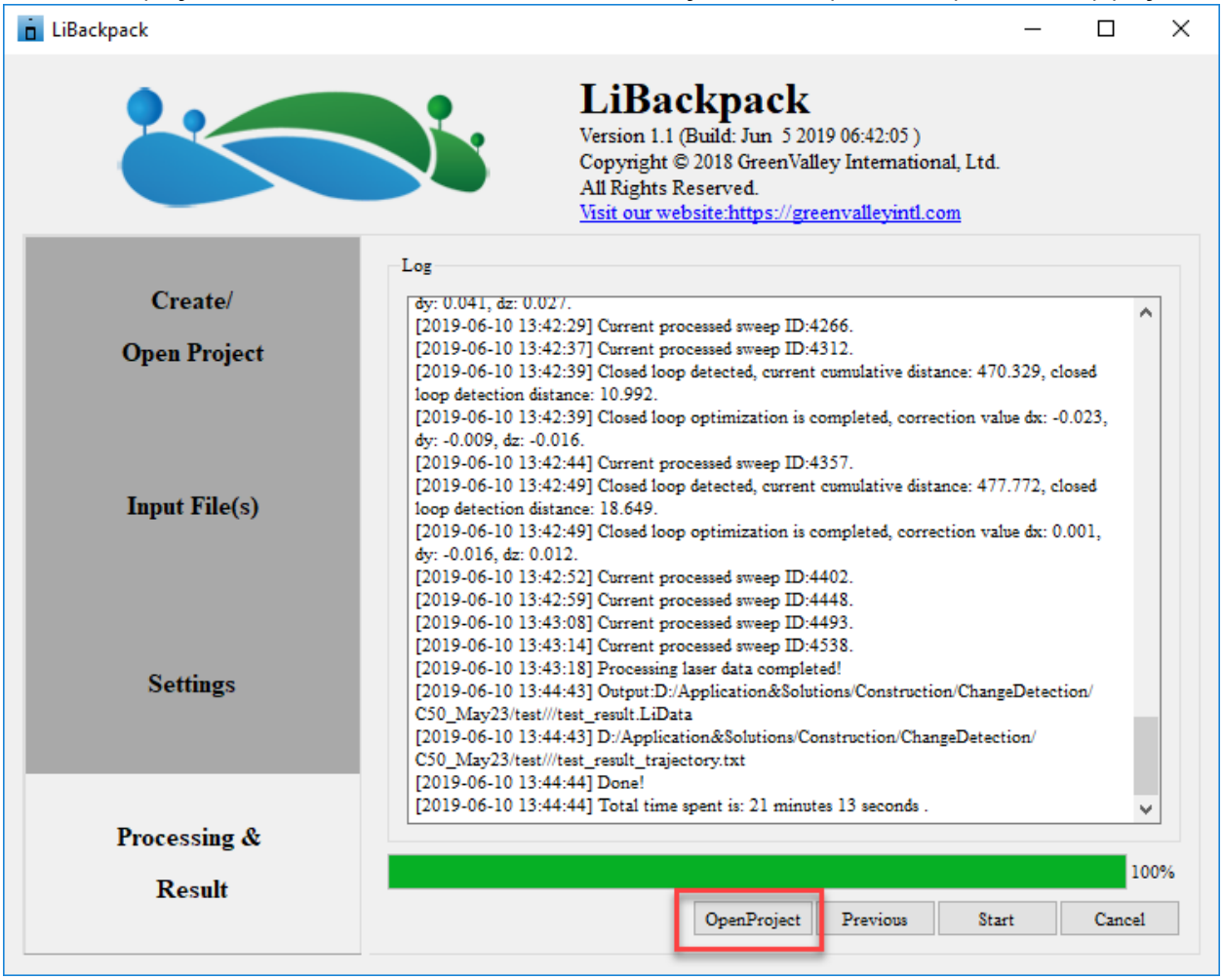


Create Project

A LiFuser project can be created in two ways:

Open from LiBackpack Desktop

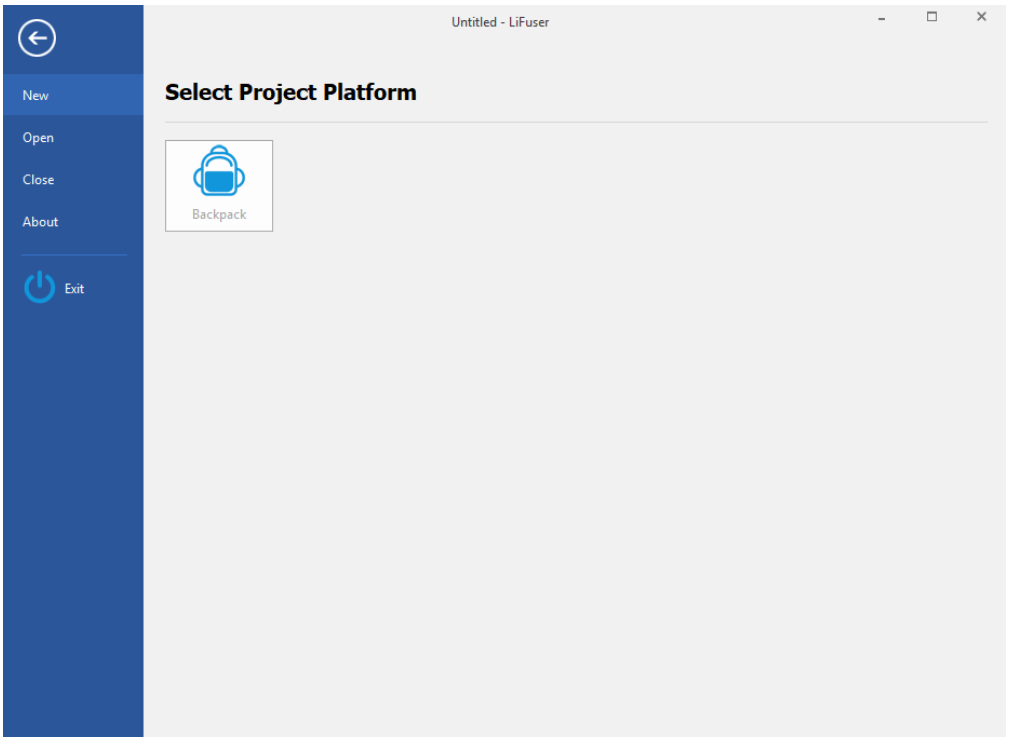
When post-processing finished in LiBackpack Desktop, click **OpenProject** to launch the project in LiFuser. A new LiFuser project will be created and saved in the same Project Directory as LiBackpack Desktop project.



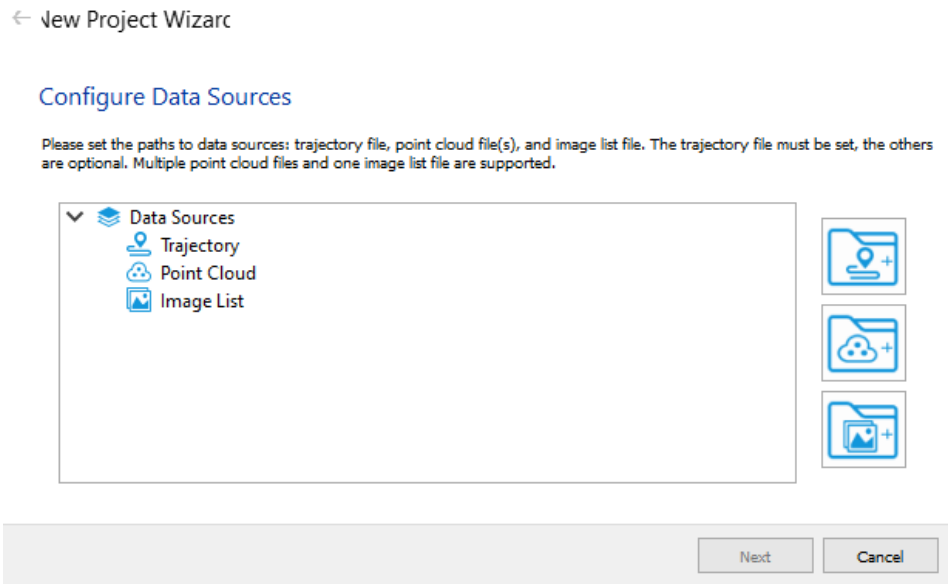
Create a New Project in LiFuser

A new project can also be created in LiFuser:

1. Launch **LiFuser**.



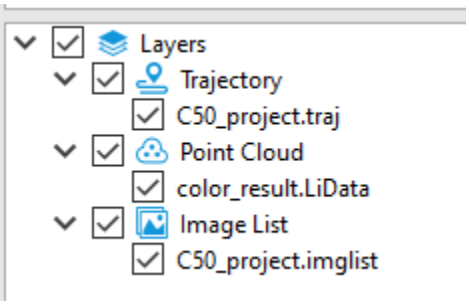
2. Click on **Backpack** in **New** page.
3. Upload **Trajectory, Point Cloud,** and **Image List (only applicable for LiBackpack C50 data)** files as following:
    a. Trajectory: result_trajectory.txt
    b. Point Cloud: color_result.LiData
    c. Image List: imglist.txt



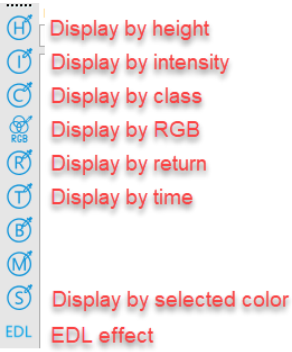
4. Select the project folder where C50 data is located and name the project. Click **Finish**.

Data Browsing

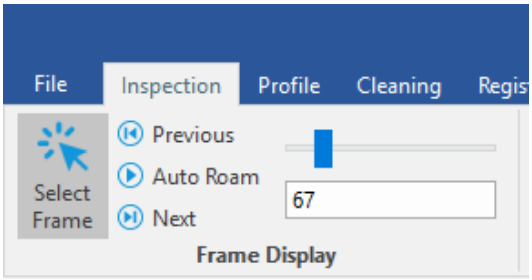
1. To turn on/off the point cloud, trajectory, and image layers in the viewers, check on/off the layer in Layers panel.



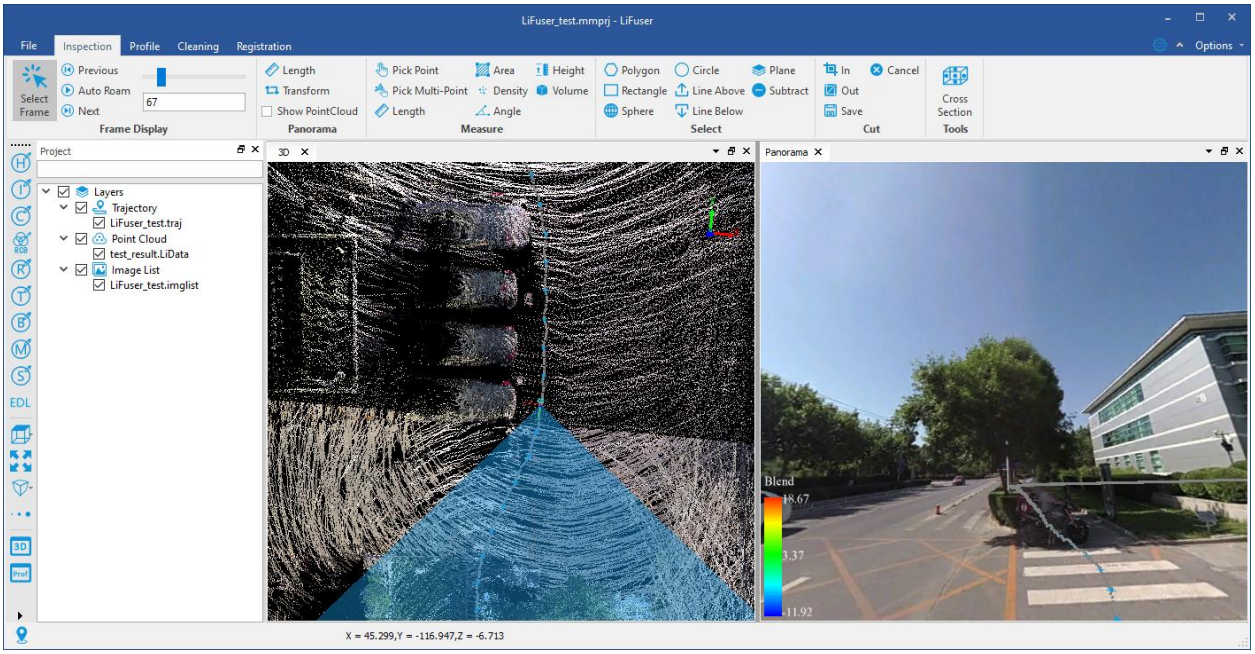
2. To change rendering options of point cloud, use the **Display** options on the left:



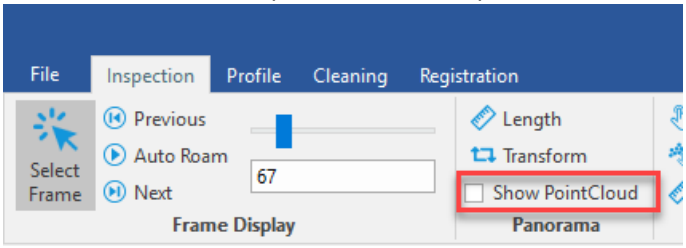
3. To view panorama photo of a location in the point cloud, under **Inspection** panel, click **Select Frame**.



4. On the left viewer, zoom in to locate the trajectory. Click on frame location, marked as arrow in blue, to open its panorama photo on the right viewer.



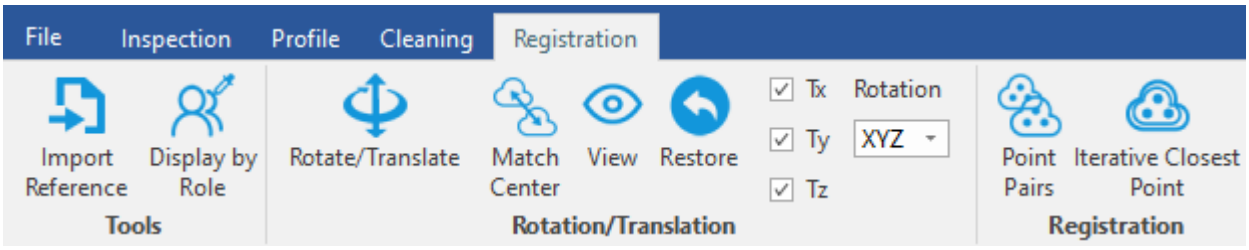
5. To turn off the point cloud in the panorama viewer, uncheck **Show PointCloud** in Panorama section.



6. Under **Inspection**, click **Auto Roam** in **Frame Display** section, the viewer will start automatically playing point cloud rendering and panorama photos along the trajectory. Click again to stop.

Registration

LiFuser provides three methods for point cloud registration: manual alignment, Point Pairs based registration, and ICP (Iterative Closest Point) registration. Manual alignment allows you to manually rotate/translate the point cloud to its target location, which is usually used as coarse alignment. Point Pairs based registration uses coordinates of the reference points and the to-be-registered points in the transformation formula for registration. ICP registration automatically finds feature point pairs in the overlapping regions between the reference point cloud and the to-be-registered point cloud and use that for automatic registration. Point Pairs based registration and ICP registration are usually used as fine alignment, which need to be done after the coarse alignment.



Register a point cloud to another reference point cloud

To register one point cloud (to-be-aligned point cloud) to another point cloud (reference point cloud), either ICP registration or Point Pairs registration can be used. To ICP registration, which is considered as fine alignment, a course alignment, manual alignment, needs to be done first. The same methodology applies to stitching two point clouds together as well when these two point clouds have overlapping areas.

1. Coarse alignment – manual alignment

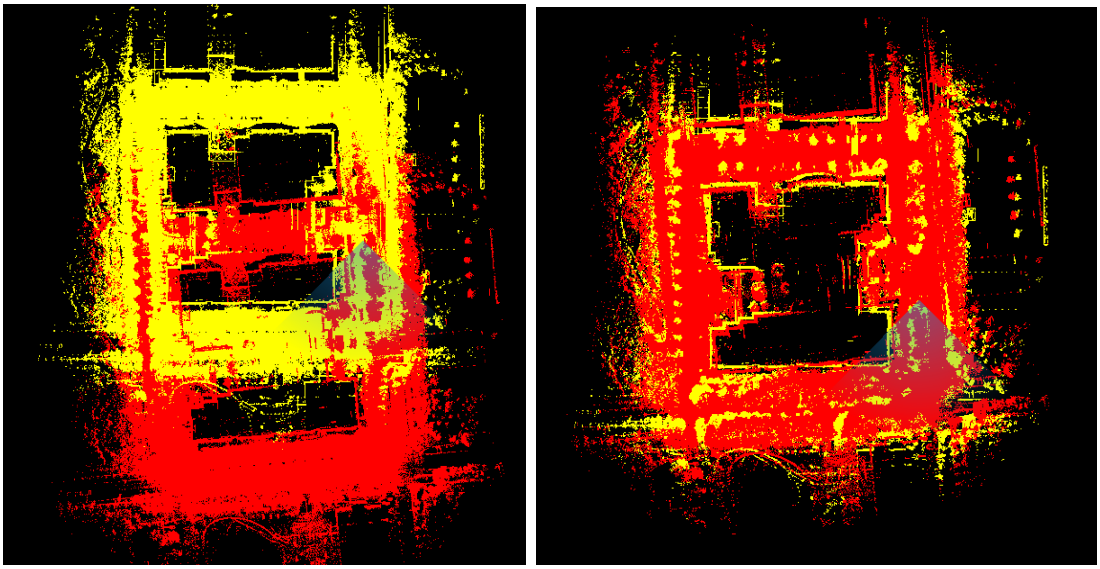
1.1. Follow instruction above to load a project.

1.2. Under **Registration** tab, in the **Tools** group, click **Import Reference**, and select your reference point cloud to open. The reference point cloud will be added to the same view as the to-be-aligned point cloud.

1.3. Click **Display by Role**. This tool renders two point clouds in two different color for differentiation.

1.4. Click **Rotate/Translate** in **Rotation/Translation** group to activate the tools.

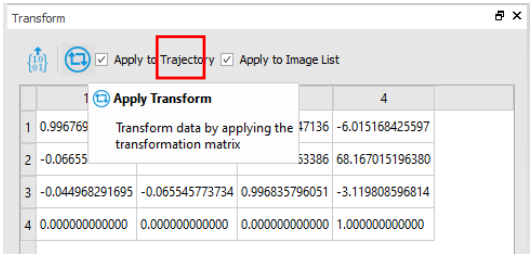
1.5. If two point clouds are too far away, you may click **Match Center**, which aligns the centers of the bounding boxes of these two point clouds.



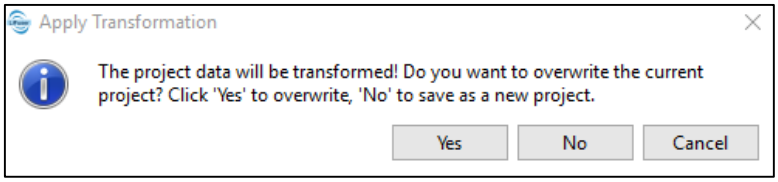
Point clouds before and after Match Center

1.6. Click/drag on the view to move/rotate the point cloud to further match the reference point cloud.

1.7. Click **Apply Transform**  in **Transform** window



1.8. In the pop up window, click **Yes** to transform and overwrite the current point cloud, or click **No** to save a new transformed point cloud.

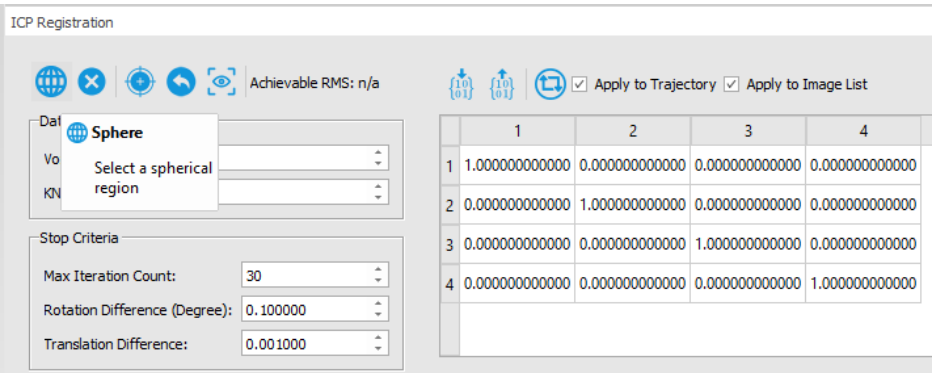


If a new point cloud is generated, you would need to open the new project, and re-add the reference point cloud.

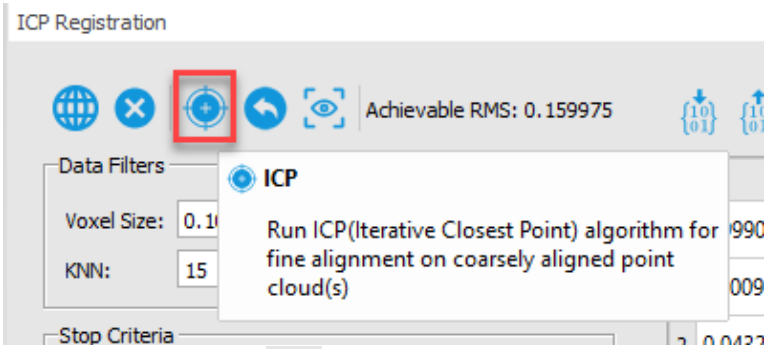
2. Fine alignment – ICP registration

2.1. Click **Iterative Closest Point (ICP)** to activate the ICP registration tool.

2.2. Click **Sphere** tool and click on an overlapping region of two point clouds. Drag and double-click to select. The selected overlapping region will be used for ICP. Multiple regions can be selected.
Note: It is recommended to place the sphere center at the junction between a wall and the ground, or a tree trunk in the overlapping region. The radius of the sphere is usually ~5m.



2.3. Click **ICP** to run ICP.



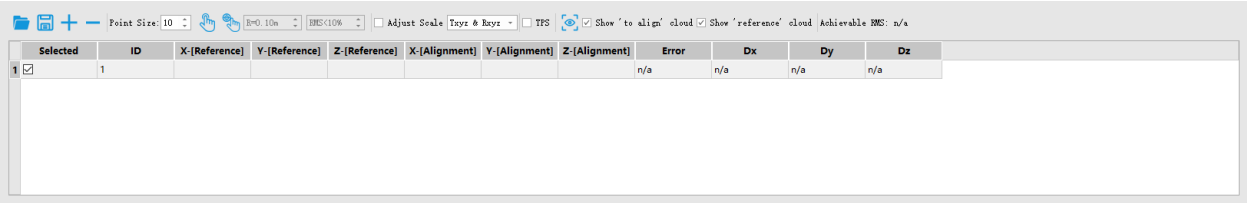
2.4. Click **Preview** to view the result on-the-fly.

2.5. To reset the parameters, click **Reset** .

2.6. Once satisfied with the result, click **Apply Transform** to apply transformation.

3. Fine alignment – Point Pairs registration

3.1. Click **Pick Point Pairs** to activate the GCP registration tool.



3.2. Click **Pick Registration Sphere** to pick registration sphere or click **Pick Points** to select registration point in the aligned point cloud. If Pick Registration Sphere is used, the selected sphere will be fitted automatically and the centroid of the sphere will be used as the matching point. It is highly recommended to use registration sphere to achieve high registration accuracy.

3.3. After selecting the picking mode, set the parameters of it. If Pick Points mode is selected, set the size of the points displayed in the window;if Pick Registration Sphere mode is selected,set the size of the registration sphere (radius R) and the **RMS** (Root Mean Square) of the fitting sphereThe smaller RMS is, the stricter the algorithm is set to fit sphere, and the more accurate the fitting result is tend to be.

3.4. Click on the point/sphere in the to-be-aligned point cloud, and then click on the corresponding point/spher in the reference point cloud.

3.5. Click **Add Point** button  to add another point pair or select and click Delete Point button to delete. At least 4 point pairs are required for Point Pair registration.

3.6. Check on TPS checkbox to use TPS (Thin Plate Spline)-based non-rigid transformation to minimize residual errors of transformation result.

3.7. Click **Preview**  to view the result on-the-fly.

3.8. Once satisfied with the result, click **Apply Transform**  to apply transformation.

4. Register a point cloud using GCPs

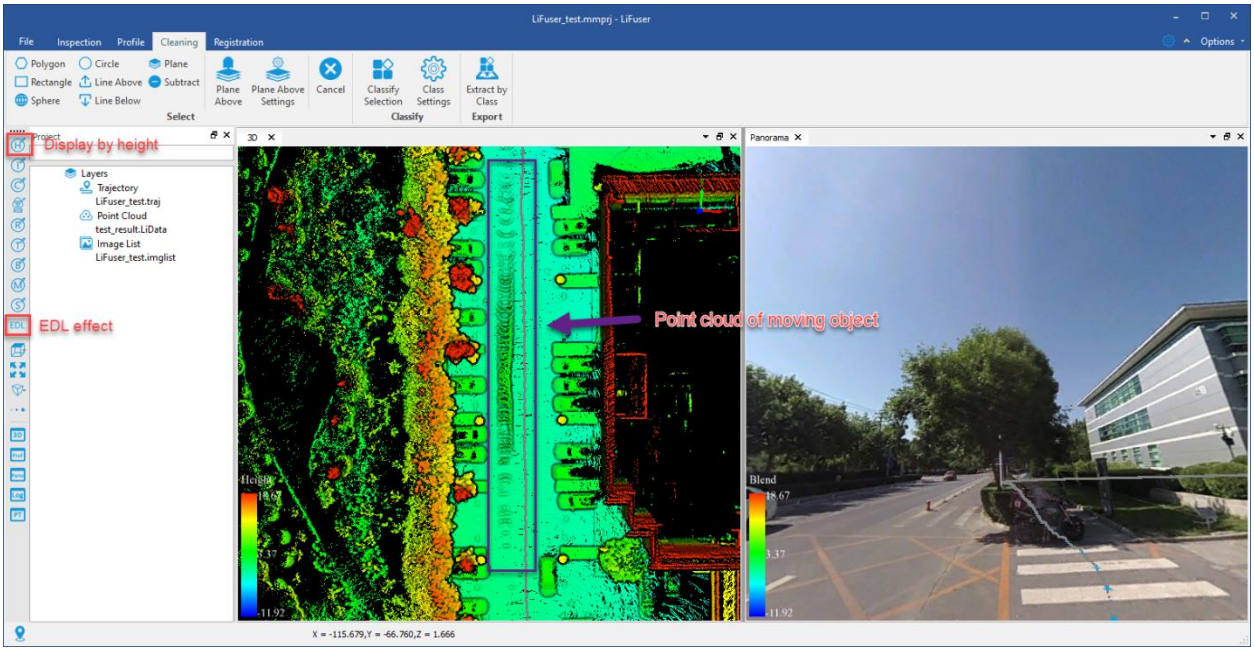
To register a point cloud using GCPs, use the Point Pairs registration method. The workflow is the same as registering a point cloud to another using Point Pairs registration method above, except that instead of picking corresponding points/spheres in the reference point cloud, you would need to enter the coordinates of the GCPs in the X-[Reference], Y-[Reference], Z-[Reference] columns.

Data Cleaning

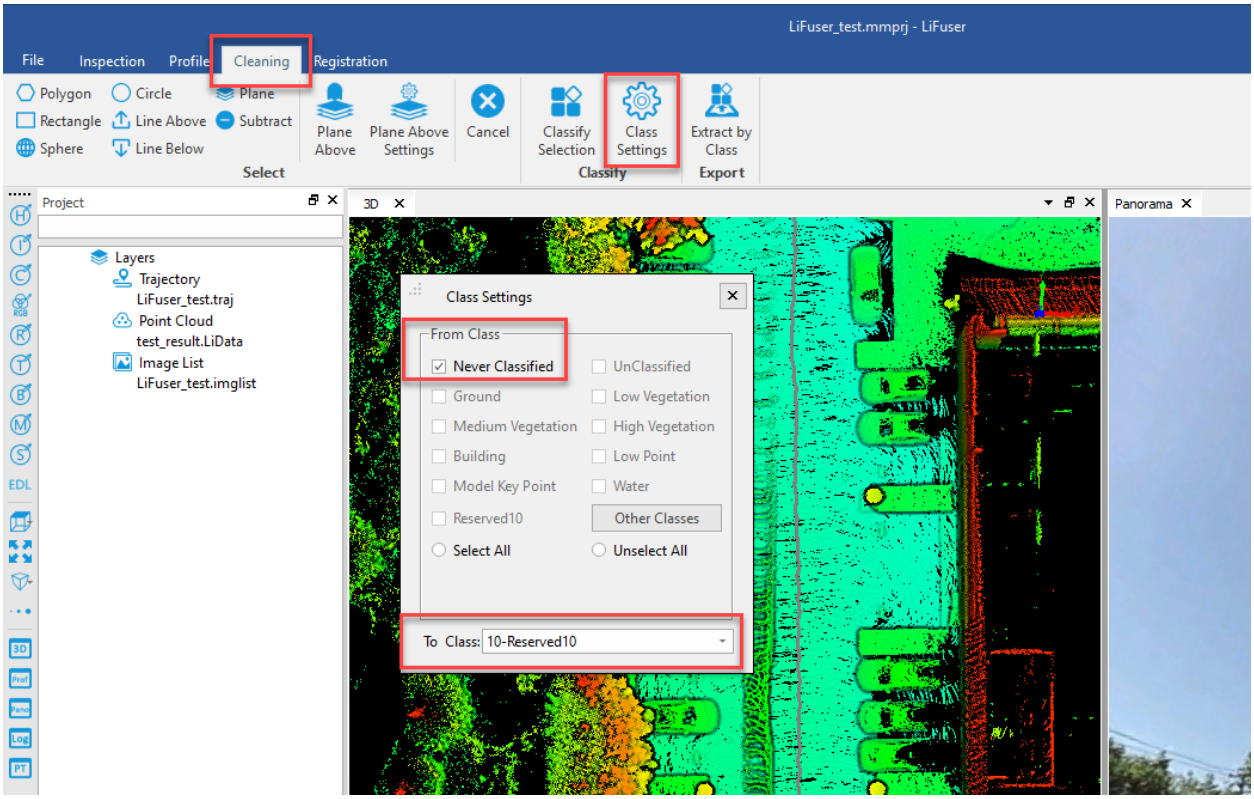
LiFuser provides tools for data cleaning under the **Cleaning** tab, with which clusters of points can be selected and reclassified into a new class which can be discarded when extracting the rest points into a new point cloud file.

Particularly, the **Plane Above** tool can be used to select objects above the ground, for example, moving cars and pedestrians. User will click on the point cloud to select a ROI first, and the tool will fit a plane over the clicked points. The points above the plane will then be selected. After being selected, points of moving objects can be reclassified into a separate class and removed afterward. Here is an example workflow of removing points of moving cars in LiFuser:

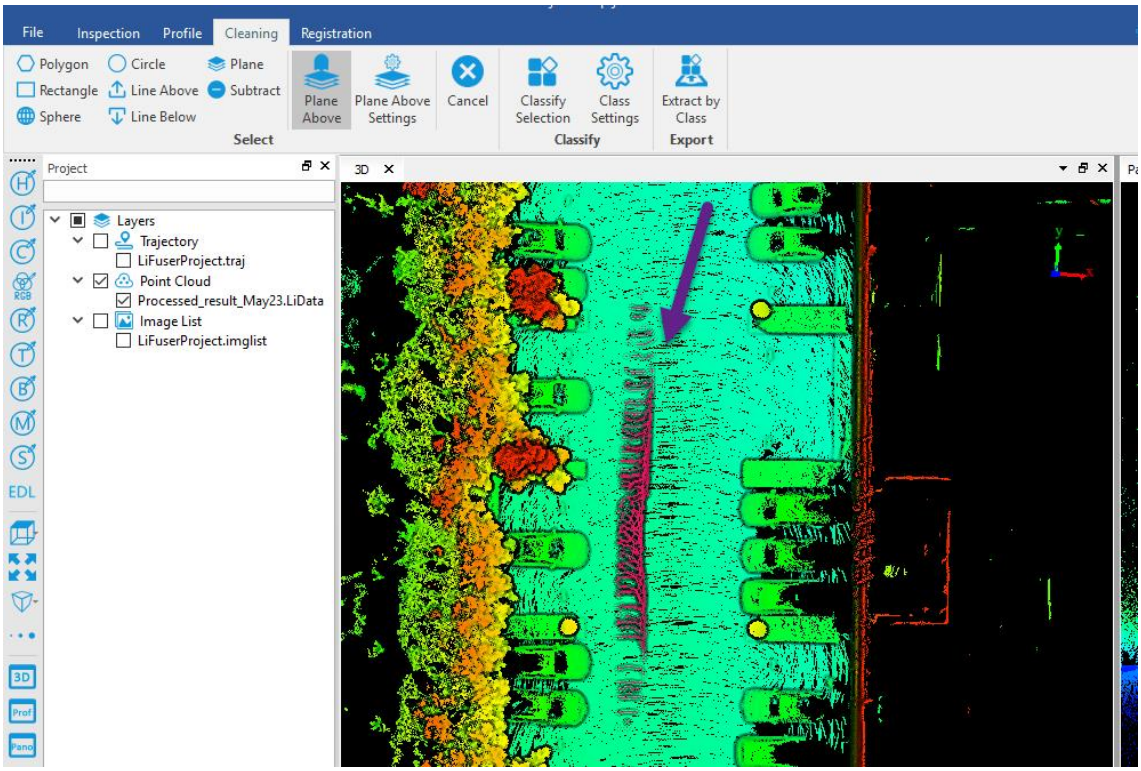
1. Switch display option to **Display by Height** and turn on **EDL** effect to identify moving objects.



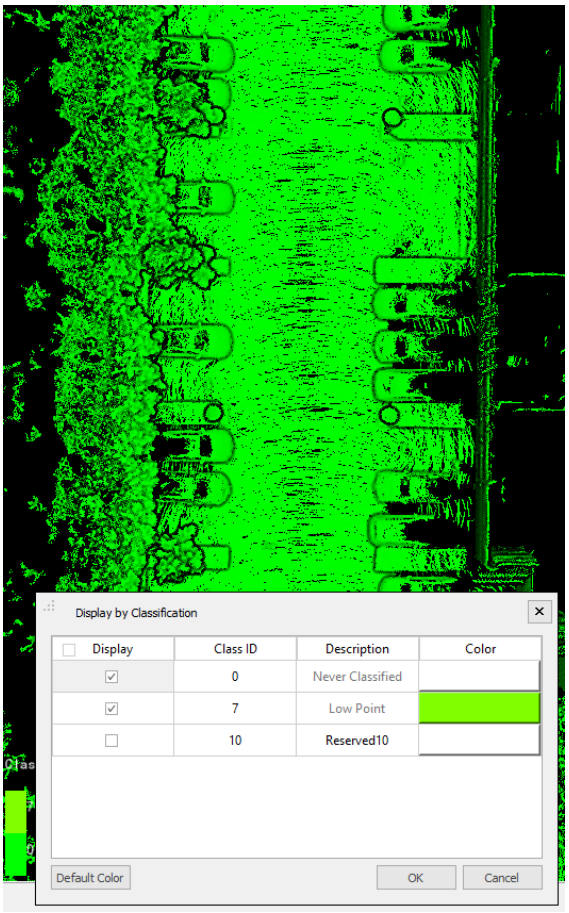
2. Click on **Cleaning** tab to display the Cleaning toolset.
3. Click on **Class Settings**. Under **From Class**, check on all the classes which contain moving objects, and change **To Class** to a class that will be used to contain the points of the moving object. In this case, the Class 10 – Reserved10 is used. Note: Reserved classes are usually used as user-defined classes.



4. Click on **Plane Above Settings**. These settings define the plane fitting and point selecting parameters.
    - Min Dis Above Plane (m): the minimum distance from the plane above which points will be selected.
    - Max Dis Above Plane (m): the maximum distance from the plane below which points will be selected.
    - Plane Thickness (m): the thickness of the fitting plane. Default value can be used under most circumstances.
    - Robust Fitting: whether robust fitting is used. Default value (checked) can be used under most circumstances.
5. Click on **Plane Above** to activate the tool.
6. Click to draw a polygon around the area of the moving object and double-click to finish. The selected points are in purple.



7. Click **Classify Selection**. The selected points will be classified into Class 10 – Reserved10.
8. Switch Display Option to **Display by Classification** and uncheck Reserved10. Click OK. The moving object disappeared from display.



9. Use the same method to classify other moving objects. You may switch Display Option back to **Display by Height** or **Display by Mix** (display selected classes of points by height, intensity or GPS time) to help identify moving objects.
10. Click Extract by Class in Export panel. Make sure Researved10 is not selected as From Class. This tool extracts points in the From Class and save them as a new class. As a result, the moving objects are removed in the new point cloud file.