# PointCab TUTORIALS

### **Target-based registration for surveyors**

### 1. Necessary presets

Go to File > Settings and the Registration tab. Here you can set the default for the a-priori accuracies of the features (targets, spheres, points), as well as the possible geodetic points (references).

The decisive factor is the ratio of the accuracies. Note that points are usually less accurate than targets and spheres. If geodetic points were measured with GPS, you can assume an accuracy of e.g. 30 mm can be assumed.

Furthermore, you can set whether to search for targets and/or for which sphere types. These settings are automatically applied in every new project.

In the Sketch/Panorama tab, deactivate the Colorized panoramas setting to be able to use quickly load scan views later as reflectivity images.

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#### 2. Create a project and import scans

Start a new PointCab project with New > Advanced Importer. Give the project a name and save it in the location of your choice. This will automatically open the Advanced Importer.

Now, using Windows Explorer or a similar file browser, open your folder containing the FARO scans in raw format. Select all scan folders together and drag and drop them into the free area of the Advanced Importer.

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Select "No" when asked if the scans are already registered.

All scans for import will now be listed automatically. Use the same method to add Add any additional scans using the same method.

Then start the import of the scans by clicking on "Start". The import may take some time depending on the number of scans, the data type, the scan size and your computer equipment.

Note: In case of FARO scans, the colorization is done automatically. Provided your computer has enough CPU cores and memory, multiple scans will be imported simultaneously. We recommend an SSD hard disk as system hard disk for fast import.

#### 3. Create cluster (optional)

After importing, the registration editor opens automatically. For a large project, it is recommended to create the clusters before registration and sort the scans in the clusters. It simplifies and speeds up the iterative error-search process in the registration (Left: before creating the clusters, Right: after creating the clusters).



#### 4. Registration Editor

After the import, the Registration Editor will open automatically.

Make sure that both the Job List and the Job Editor are displayed on the right (Main Toolbar or Views ... menu).

The Registration Editor consists of 3 sections. In the upper area there is a dual view of two scans, with the help of which you can easily click point correspondences. You can switch the scans manually for the left and right side in the selection list.

If you don't need point correspondences, you can reduce or completely hide the right view by click&drag in the area between the two views. Below the dual view there are two hidden lists "Scans" and "Targets & Spheres ...", which you make visible by clicking on the triangle.

In the scan list all available scans are listed; in the feature list all available targets, spheres etc. are visible (currently empty).



The corresponding settings for registration are displayed in the job editor. If not, click once on the "Registration" job in the job list to select it.

You can now adjust both the setting from the default setting for the accuracies of the features, as well as for the feature search again individually for this project.

If you have used external geodetic points in your project and would like to import them, rightclick in the feature list and select "Load coordinate file" from the context menu. You will be shown the corresponding file formats and you can then import your coordinate file, which will appear in the list.

Note: You can sort the lists according to the column entries by clicking in the header.

#### 5. Feature search

Start the registration job in the job list. You will get a message that some scans do not have enough features and that they can be searched automatically. Confirm this with "Yes". In the job list, a feature search job is created for each scan and started automatically.

In the scan list you will see the column "Characteristics", which shows the number of characteristics in the respective scan. If only 2 or less features are found, the entry is red. If 3 or 4 features are found, the entry is yellow - otherwise green.

While searching in all scans, you can open a corresponding scan in the above view and set it manually with the "Sphere" or "Target" tools. This saves a lot of time as you can continue working in parallel. For larger projects, we recommend that you visually check all scans once and manually re-measure features if necessary.

You can also open a scan in the scan list by right-clicking in the context menu that appears. In the context menu it is possible to activate / deactivate as well as to set an origin scan (if no geodetic points are used).

After finishing the search, make sure that at least 3 features were found in each scan.

#### 6. Search constellations automatically

Restart the registration job in the job list. PointCab Origins will give the same feedback, if applicable, if a scan does not contain at least 3 features. Otherwise, the constellation search is performed and mappings between the scans are searched for.

If you have not specified geodetic points as well as an origin scan, the first scan is automatically set as the origin scan.

The search automatically renames the names of the features. If constellations could be found for all scans, a positive confirmation appears and the number 1 appears in the "Group" column for all scans. Otherwise, individual scans or entire groups of scans can exist in their own group. This means that the groups could not be connected to each other.

Accordingly, check the scans for their characteristics that should connect the groups; re-measure the missing characteristics and restart the registration job. Continue this process until all scans could be connected.

Note: In some cases, the features have a bad configuration (e.g. all on one line). By enabling the "Weak Configuration" option in the Job Editor, these will be included. If scans were not scanned roughly vertically, turn off the Scans Vertically option. You can increase the search factor to find more uncertain mappings, but this increases the probability of a wrong mapping.

#### 7. Optimize registration

At this point, all scans are pre-registered as well as blue in the scan list; Orientation data of the scans are available.

In the 3D view, which you can open in the main toolbar, you can see the scan positions as well as geodetic points if available.

In the feature list you can see the initial residuals for each feature, i.e. the deviation of each feature from the mean value of all three-dimensional coordinates of the features. The color shows you how large the residuals are in terms of a-priori accuracy. Red residuals show you large deviations. Check them and delete the corresponding features if necessary; start again with 5.



#### 8. Complete registration and create protocol

In the Job Editor under the File tab, you can rename the log file if necessary.

Then start the registration job again to write the protocol and complete the registration.

The registration editor closes and the three default views are created automatically.

### **Register manually**

With target marks and reference spheres, high accuracies can be achieved for larger projects. In some applications such as the documentation of accident and crime scenes, in the craft sector such as staircase or kitchen construction or facade documentation, the number of scans is small and faster acquisition is necessary. In this case, the user would like to do without active targets and use natural points.

This is of course easily and reliably possible with the registration in PointCab Origins.

#### **1. Registry Editor**

After the import, the Registration Editor will open automatically.

In the scan list all available scans are listed; in the feature list all available targets, spheres etc. are visible (currently empty).

A selected job "Registration" is displayed in the job list. The corresponding settings for registration are displayed in the job editor. If not, click once on the "Registration" job in the job list to select it. You can now adjust both the setting from the default setting for the accuracies of the features and for the feature search again individually for this project. Set the search for targets as well as spheres.



Note: You can sort the lists according to the column entries by clicking in the header.

#### 3. Set correspondences (matches) manually

In the dual view, select two scans that overlap.

Use the "Correspondence Points" tool and select the same point in both scan views. If possible, use points that are easily identifiable and have the greatest possible distance in both scans. Repeat the process at least 3 times.

If you have measured more than 3 correspondences, the registration quality is calculated under the scan views. Try to increase the accuracy by adding more correspondences.

Perform the process with more scan combinations so that all scans are connected.



Note: You can also open a scan in the scan list by clicking the right mouse button in the context menu that appears. In the context menu it is possible to activate / deactivate as well as to set an origin scan.

#### 4. Automatic placement

Start the registration job in the job list to start the placement.

If you have not specified an origin scan, the first scan will be used automatically.

If all scans could be placed, a positive confirmation appears and the number 1 appears in the "Group" column for all scans. Otherwise, individual scans or entire groups of scans may exist in their own respective group. This means that the groups could not be connected to each other.

Accordingly, check the scans for their characteristics that should connect the groups; re-measure the missing characteristics and restart the registration job. Continue this process until all scans could be connected.

Note: In some cases, the features have a bad configuration (e.g. all on one line). By enabling the "Weak Configuration" option in the Job Editor, these will be included. If scans were not roughly scanned vertically, turn off the Scans Vertically option.

#### 5. Optimize registration

At this point, all scans are pre-registered as well as blue in the scan list; orientation data of the scans are available.

In the 3D view, which you can open in the main toolbar, you can see the scan positions. In the feature list you can see the initial residuals for each feature, i.e. the deviation of each feature from the mean value of all three-dimensional coordinates of the features. The color shows you how large the residuals are in terms of a-priori accuracy. Red residuals show you large deviations. Check them and delete the corresponding features if necessary; start again with 3.



Start the registration job again.

PointCab Origins now performs a global optimization. The scan positions are optimized and the sum of squares of the residuals is minimized (Least Square Adjustment).

After the adjustment, all scans are green (origin scan magenta). Check the residuals again. If necessary, delete corresponding features, set the Incremental option off and then start again with 3.

#### 6. Complete registration and create protocol

In the Job Editor under the File tab, you can rename the log file if necessary. Then start the registration job again to write the protocol and complete the registration. The registration editor closes and the three default views are created automatically.



If a PDF viewer is installed, open the log by double-clicking the registration job. In it you will find detailed information about the calculated registration with accuracy information, a visualization of the feature graph, a detailed listing of observations with residuals, and an accuracy analysis of the relative accuracy between scans.

#### Lock cluster

Option "Lock Cluster" is used to register the scans under constraint to the alignment of the locked cluster. There may also be only one scan in the locked cluster. In this case, all scans to be registered are aligned after one scan. In the "Barn" example, the scans were registered in cluster "Day 1". New scans were added in cluster "Day 2". These new scans are to be registered after the alignment of cluster "Day 1".



All clusters in the project are located in the "Advanced Importer" under the "Clusters" tab. By clicking with the right mouse button on cluster "Day 1", pop-up options appear in which "Lock Cluster" can be activated. Then the "Registration" job should be switched back to the editing mode.



After activating the scans in cluster "Day 2", "Search Features" can be started in tab "Registration" for the scans of cluster "Day 2". If the minimum number of features found is greater than or equal to 3, one can continue with "Find Constellation". After that, the residuals should be checked before the final registration. At the end, the adjustment can be done for all scans. After adjustment, the newly added scans are aligned exactly according to cluster "Day 1".

