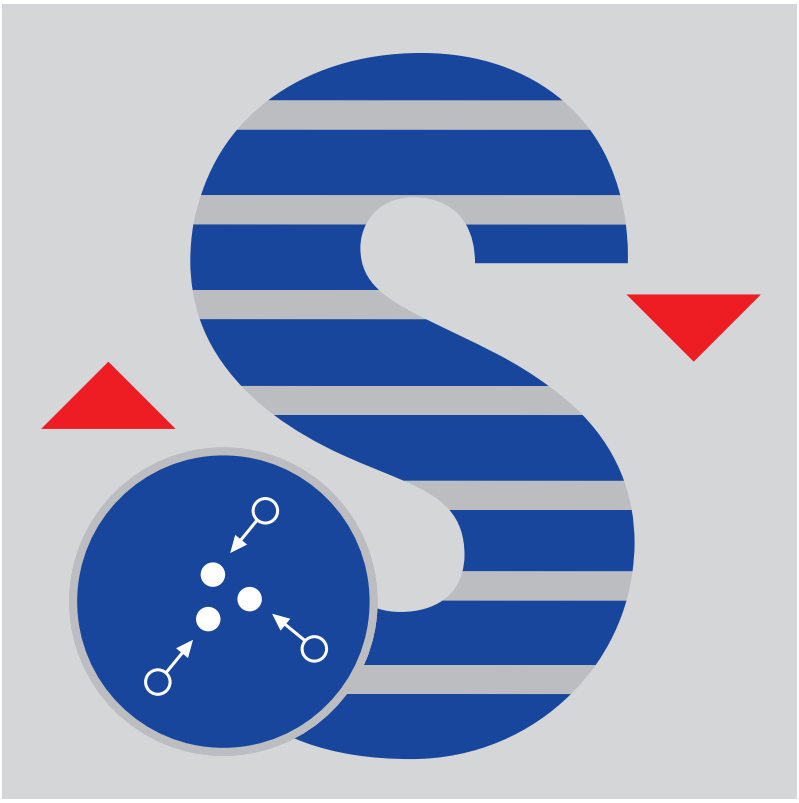
Automated Registration

User Manual 05/2017



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Automated Registration

1 Introduction

Automated Registration is a SCENE Plugin which simplifys the registration in order to save time and trouble. Thereby the workflow is nearly the same, the time needed to registrate a project can be significantly reduced, especially when more than 50 scans are conducted. Even though the first run of Automated Registration might not be successful, it will reduce subsequent manual work.

2 Installation

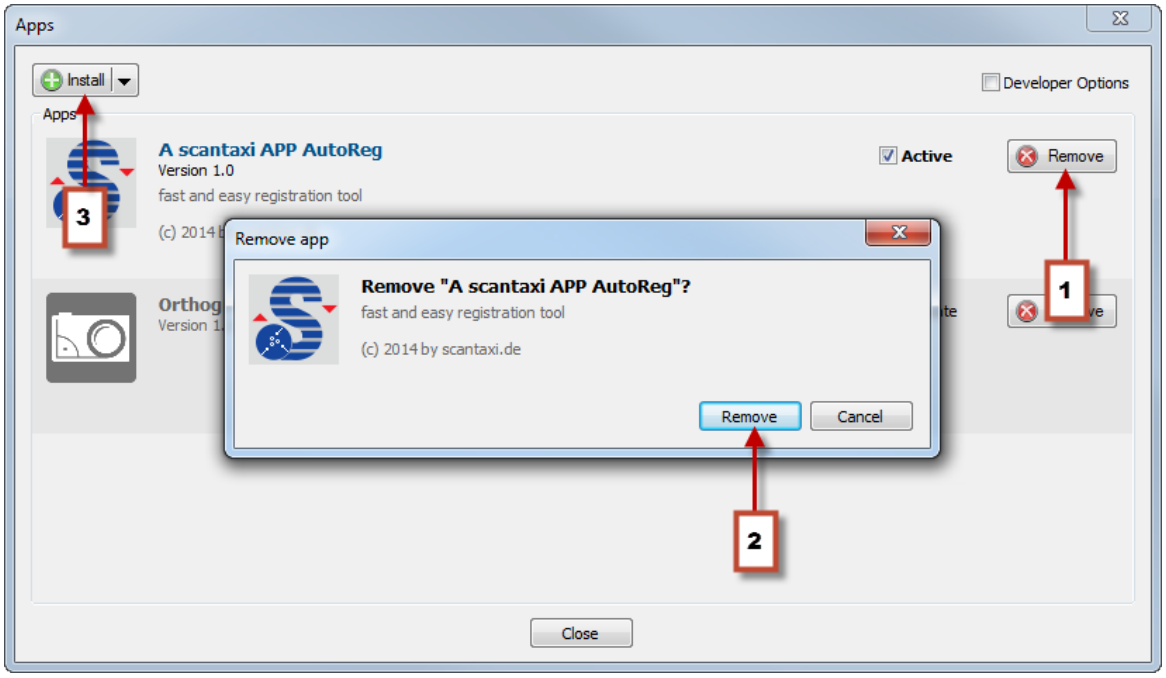


Figure 1: SCENE App Centre

As part of the installation procedure of the new version, the old version has to be removed (1, 2). Following this, Automated Registration can be installed via App Manager (3), drag and drop or by double clicking on the app file in the Explorer.

scantaxi software: `http://www.scantaxi.de/software.html`
Latest version: `http://www.scantaxi.de/software/AutoReg.html`

3 Licensing

3.1 License models

Automated Registration is available as:

3.1.1 Full license

- Automated Registration can be used without any limitation
- a license can be purchased in the FARO 3D App Center (`http://www.faro.com/faro-3d-app-center`)
- See chapter 3.2 for activation process

3.1.2 Demo project license

- Automated Registration can be used without any limitation for one licensed project
- the project license can be requested under license@scantaxi.de
- See chapter 3.2 for activation process

3.1.3 Demo (limited functions)

- Automated Registration can be used without a license
- range of functions is limited

3.2 Activation process

Starting Automated Registration without a license will open the license dialog (Fig. 2). Within this dialog the following options are available:

- Request and enter full license code (1)
- Create a request file for the current project (2)
- Load the license file for the project received from license@scantaxi.de (3)
- test Automated Registration with limnited range of functions (4)

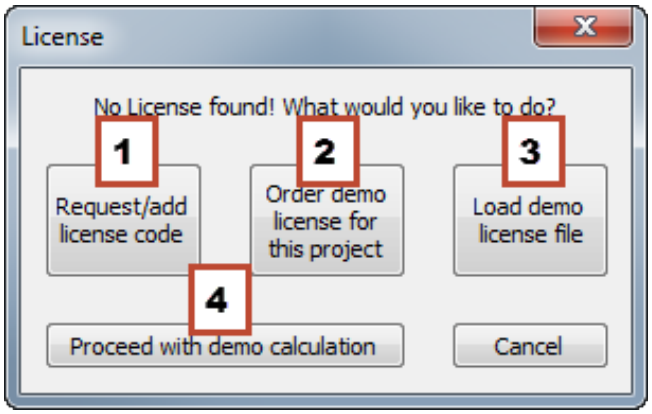
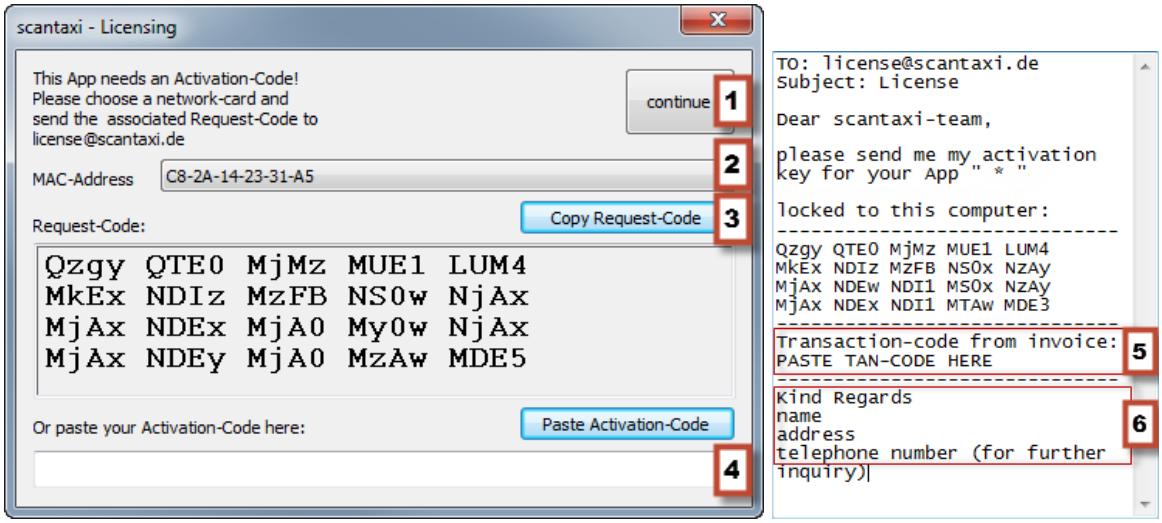


Figure 2: license dialog

Automated Registration

3.2.1 Request/enter full license code



- Select a MAC address (2)
- Press "Copy Request-Code" to copy the e-mail to the clipboard (3)
- Copy clipboard to email
- Enter transaction number from invoice (5) and your contact information (6)
- Send e-mail to license@scantaxi.de
- Paste received activation code (4)
- Activate license (1)

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3.2.2 Request/load project-based license

Before the request file can be generated, some personal information and valid TAN's need to be entered into the personal information dialog. This dialog will give an approximate estimate of how many coins are probably required.

After generating the request-file an e-mail must be sent to license@scantaxi.de. Usually the license will be provided within 24 hours and can be loaded via the license dialog box.

Important! The project-based license will work with the scans stored in the project before generating the Request-Code! New scans will not be accounted for.

The personal information is coded in the request-file. All fields must be filled out (Fig. 3) or the request will not be processed.

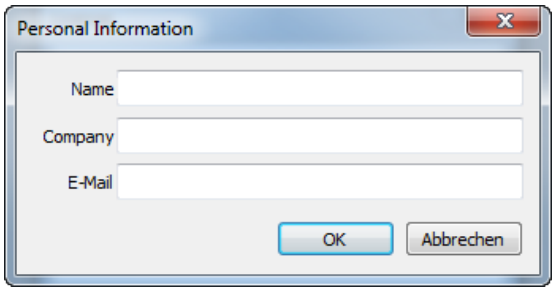


Figure 3: enter personal information

Automated Registration

4 Automated Registration settings

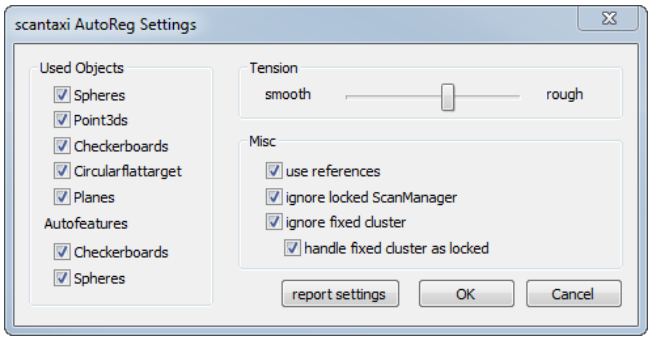


Figure 4: Automated Registration settings dialog

- Used objects

  which objects should be used for registration - unchecked objects will be ignored

- Tension

  adjusts the maximum accepted tensions

  if Automated Registration finds incorrect correspondeces it can be set smoother or rougher and the registration can be retried

- Misc
  - use references

    if global references are set, Automated Registration will use them
  - ignore locked ScanManager / fixed cluster

    scans in fixed clusters or in clusters with locked scan manager will be registered like all other scans, ignoring the clusters

    otherwise the whole locked/fixed cluster will be handled like a single scan
  - handle fixed cluster as locked

    scans in fixed cluster don't loose their connection, but can be moved and rotated together

- report settings

  see chapter 9.5

5 Successful registration

Scanning tips

- Reference placement

  references should be placed in different heights with different distances (Fig. 5a)

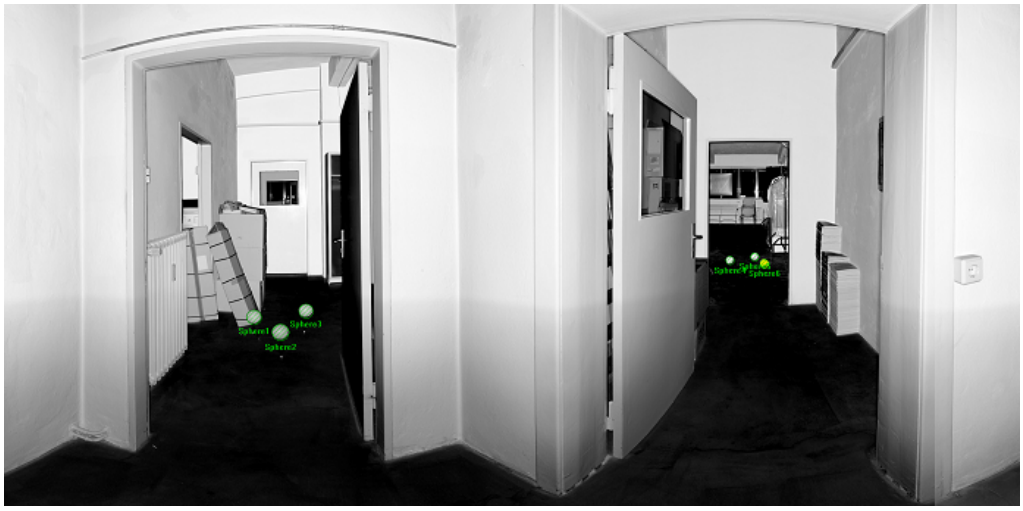
  an accumulation of references should be avoided (Fig. 5b)

- For each scan Automated Registration requires

  three shared references

  correct inclinometer data

(a) good example of reference placement



(b) bad example of reference placement

Figure 5: reference placement

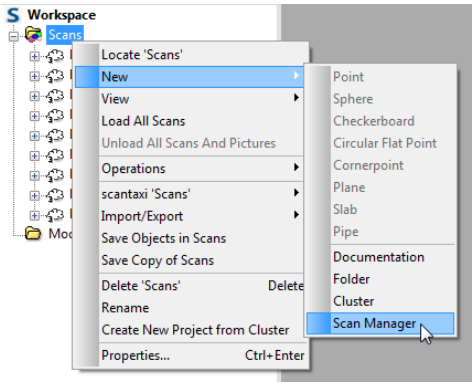
Automated Registration

Automated Registration preprocessing

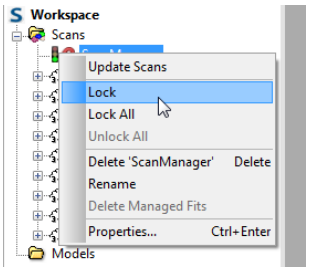
The naming of the references is irrelevant as it will be ignored by Automated Registration. The references only need to be marked. A grouping of the scans into cluster is not necessary. A rough classification into cluster is suggested for checking the registration in the end.

Preregistered scans

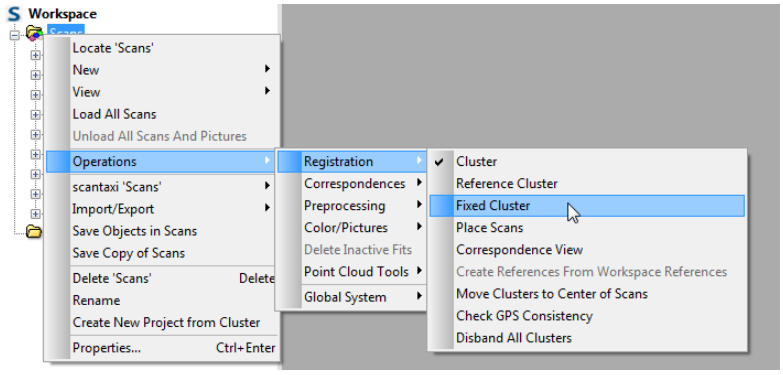
Preregistered Scans have to be collected in clusters. If they should stay in position on registration, the clusters have to be fixed (fig. 6c). A locked Scan Manager (Bild 6a, 6b) must be created in the cluster, if connection between the scans should be kept, but the positions between the clusters is allowed to change (move/rotate). Fixed clusters or clusters with a locked Scan Manager will be handled like a single scan and can be registered even with 3 references.



(a) create Scan Manager



(b) lock Scan Manager



(c) Fix Cluster

Figure 6: Fixed cluster / Locked Scan Manager

Automated Registration

Start Automated Registration

When all references in every scan are marked, Automated Registration can be started.

- menu: "scantaxi/AutoReg/  Start Registration"
- toolbar:  Start Registration

Automated Registration should finish small projects within a few seconds. For some 100 scans, registration will take several minutes depending on the settings and placement of references. After a successful registration a report dialog will be provided (chap. 9). From experience big projects will fall into cluster and the AutoReg Cluster Dialog (see 8) is shown.

6 Tips for troubleshooting using Automated Registration

Dissatisfying registration results can be caused by

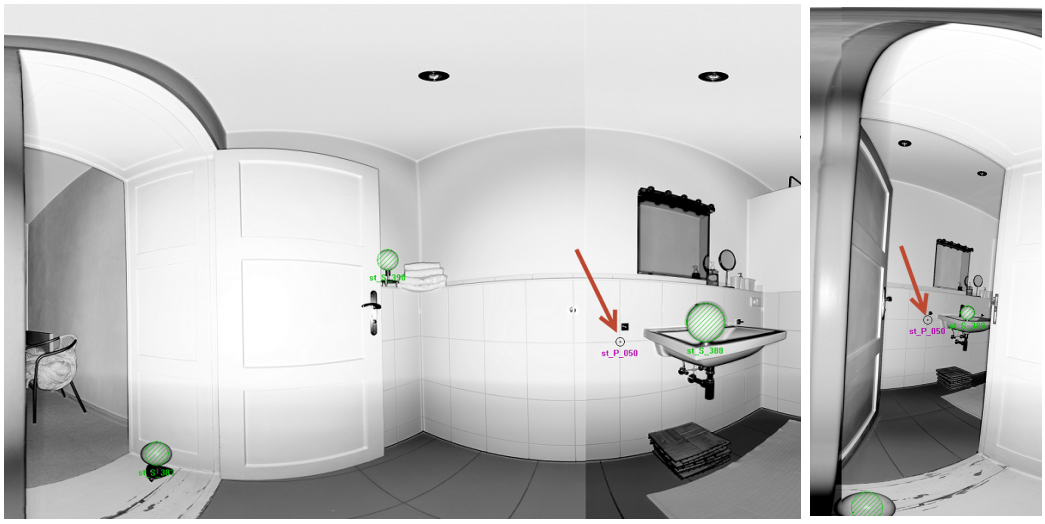
- Overlooked references
- Insufficient shared references
- Poor max tensions settings
- Incorrect reference correspondences
- Poor reference placements

Automated Registration

Automated Registration producing more than one cluster

In case that Automated Registration could not find correspondences for all scans they have checked again (see 8). References need to be added or tension settings changed (see 4). Check the scans and connecting scans for overlooked references (fig. 7). If there are scans with insufficiant artificial references (fig. 8) mark some natural points. Sometimes all natural and artificial references have to be removed and completly new references have to be marked.

Figure 7: overlooked reference



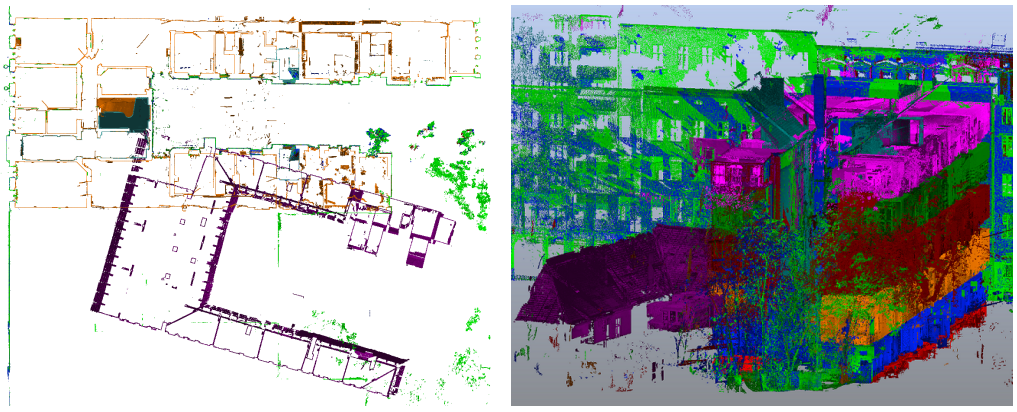
(a) (b)

Figure 8: adding natural reference

Automated Registration

How to find incorrect reference correspondences

In figure 9 a twisted top floor is shown. In some cases it is helpful to change the max tension in the settings menu. If not, the following steps could help to rearrange the twisted scans (fig. 10).



(a) (b)

Figure 9: wrong assignment

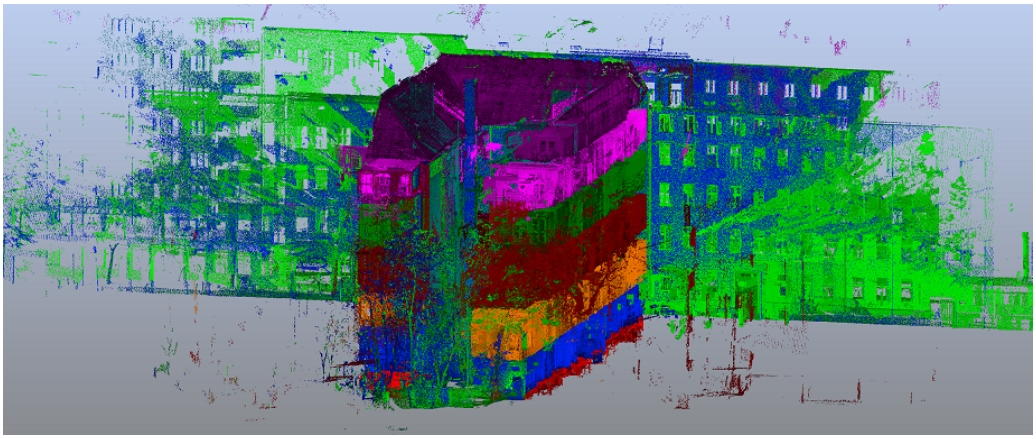


Figure 10: corrected assignment

- Find out which scans are twisted
- Search the first appearance of these scans in AutoReg Cluster (see chapter 8)
- Removing the artificial references and adding new natural references in the first scan of a cluster and the connected scan could solve the problem

Automated Registration

7 SCENE Scan Manager

If Automated Registration is used for the registration, the SCENE Scan Manager may fail anyway. In some special cases it can be created by

- Operations/Registration/Place Scans Auto
- Operations/Registration/Place Scans (Force By Manual Target Name)

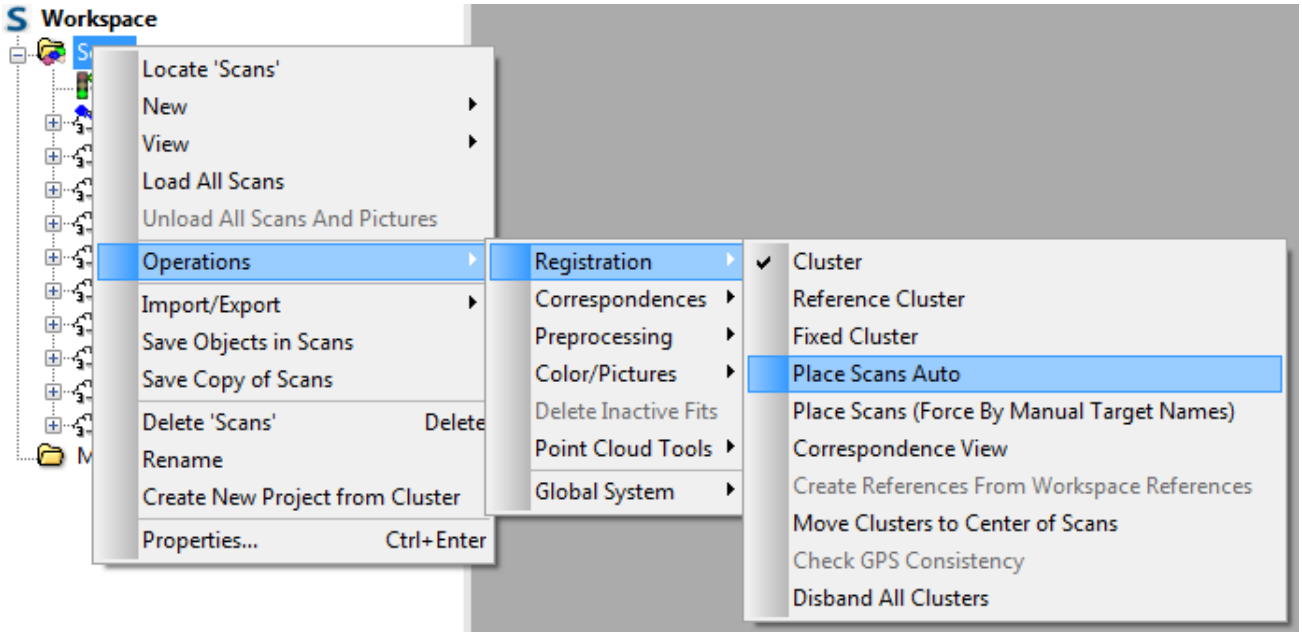


Figure 11: Place Scans Auto

The "preregistration" of Automated Registration helps SCENE to create the Scan Manager but most of the time it fails when a high number of scans is conducted (more than 100).

8 Automated Registration Cluster

The AutoReg Cluster dialog will be shown

- After an unsuccessful registration

but can also be manually started via

- menu: "scantaxi/AutoReg/AutoReg Cluster"
- toolbar:  AutoReg Cluster

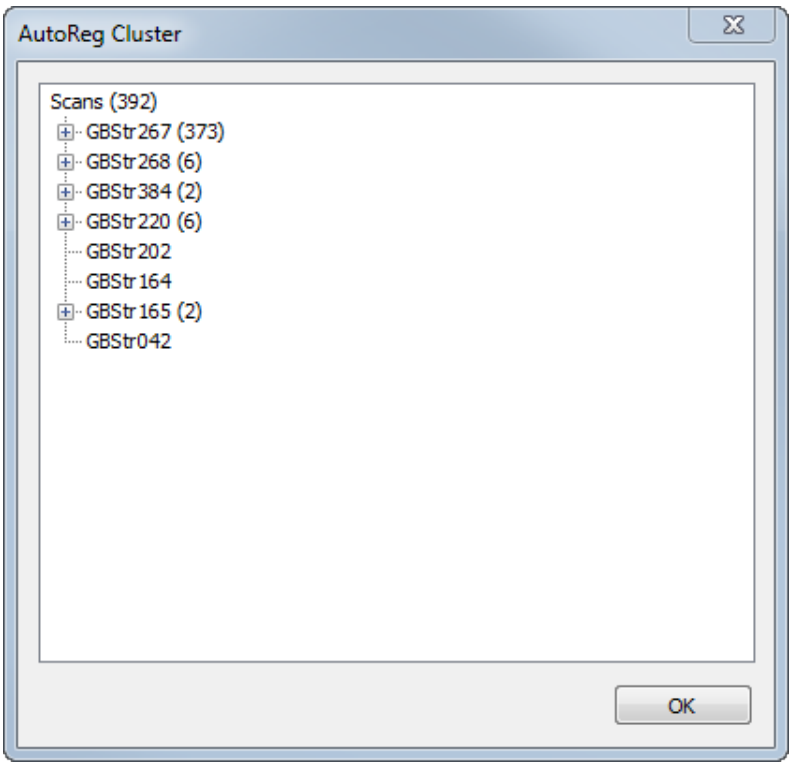


Figure 12: AutoReg Cluster dialog

The listed scans in this dialog are ordered by time of registration. This Information can be used to find incorrect correspondences (see 6) and also shows which scans belong together. Figure 12 shows the result of an example registration which created one big cluster (373 scans) and 7 small cluster. In this case Automated Registration could not find any correspondences between these 8 cluster, which necessitates manual correction. References have to be checked and may be added.

Automated Registration

9 Report functions

9.1 Scanner position

The scanner position tab will provide an overview of all scans within the project. In this tab you will get the following attributes:

1	Scan	name of the scan
2	x, y, z (m)	coordinates of the scan
3	#	number of objects used in the scan
4	mx, my, mz, mR (mm)	averaged deviation of the objects in the scan
5	Res	resolution of the scan
6	Quality	quality of the scan
7	RecTime	date and time recorded
8	ScPoi (#)	number of scanned points

Scan	x [m]	y [m]	z [m]	#	mx [mm]	my [mm]	mz [mm]	mR [mm]	Res	Quality	RecTime	ScanPts [#]
Tuch_005	10.7481	-0.4108	1.0439	9	5.7	2.6	4.8	7.9	1/2	2x	06.03.2014 12:07:01	175.356.632
Tuch_007	5.4299	14.0699	2.0352	9	2.9	1.8	2.1	4.0	1/2	2x	06.03.2014 12:20:04	175.373.700
Tuch_008	10.9370	17.6297	0.9935	9	2.8	2.1	2.3	4.2	1/2	2x	06.03.2014 12:34:19	175.322.496
Tuch_009	27.3262	16.9000	10.4421	8	2.9	1.8	2.3	4.1	1/2	2x	06.03.2014 14:16:30	175.288.360
Tuch_010	33.0925	4.6288	10.6934	6	1.1	1.9	2.4	3.2	1/4	2x	06.03.2014 14:22:15	43.805.022
Tuch_011	32.5487	-10.1586	10.6936	6	1.8	1.9	2.5	3.6	1/4	2x	06.03.2014 14:27:59	43.856.226
Tuch_012	28.8482	-15.2453	10.5842	6	3.0	1.8	1.1	3.7	1/4	2x	06.03.2014 14:31:21	43.873.294
Tuch_013	29.7971	-22.0279	10.4242	6	2.5	3.7	1.1	4.6	1/2	2x	06.03.2014 14:45:34	175.373.700
Tuch_015	10.4606	18.0165	0.8580	7	3.8	1.7	1.3	4.4	1/2	2x	20.03.2014 10:38:18	176.039.352
Tuch_016	23.4941	18.4022	0.9959	8	4.8	3.0	1.4	5.8	1/2	2x	20.03.2014 10:50:27	176.107.624
Tuch_017	28.1034	27.2171	0.8680	8	3.4	1.7	3.3	5.1	1/2	2x	20.03.2014 11:01:44	176.107.624
Tuch_019	45.6158	25.7616	1.0231	7	1.9	4.3	1.7	5.0	1/2	2x	20.03.2014 11:24:38	176.090.556
Tuch_020	57.6851	26.0614	1.0874	8	4.2	4.5	2.8	6.7	1/2	2x	20.03.2014 11:36:02	176.039.352

Figure 13: Scan position tab

If a line is double clicked, the Automated Registration automatically jumps to the all objects tab all objects of the double clicked-scan and sorts it by scan name.

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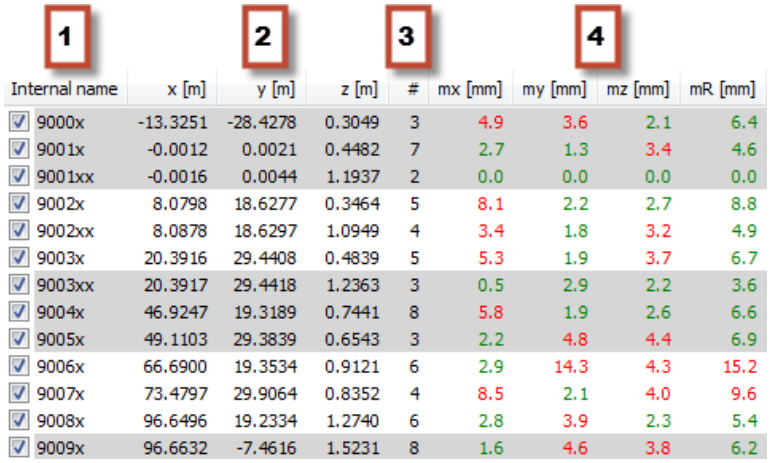
9.2 Averaged objects

This tab gives an summarized overview of the objects in the project.

1	Checkbox	use object for calculation
1	Internal Name	internal name
2	x, y, z (m)	mean of the object group
3	#	object count
4	mx, my, mz, mR (mm)	deviation



Internal name	x [m]	y [m]	z [m]	#	mx [mm]	my [mm]	mz [mm]	mR [mm]
9000x	-13.3251	-28.4278	0.3049	3	4.9	3.6	2.1	6.4
9001x	-0.0012	0.0021	0.4482	7	2.7	1.3	3.4	4.6
9001xx	-0.0016	0.0044	1.1937	2	0.0	0.0	0.0	0.0
9002x	8.0798	18.6277	0.3464	5	8.1	2.2	2.7	8.8
9002xx	8.0878	18.6297	1.0949	4	3.4	1.8	3.2	4.9
9003x	20.3916	29.4408	0.4839	5	5.3	1.9	3.7	6.7
9003xx	20.3917	29.4418	1.2363	3	0.5	2.9	2.2	3.6
9004x	46.9247	19.3189	0.7441	8	5.8	1.9	2.6	6.6
9005x	49.1103	29.3839	0.6543	3	2.2	4.8	4.4	6.9
9006x	66.6900	19.3534	0.9121	6	2.9	14.3	4.3	15.2
9007x	73.4797	29.9064	0.8352	4	8.5	2.1	4.0	9.6
9008x	96.6496	19.2334	1.2740	6	2.8	3.9	2.3	5.4
9009x	96.6632	-7.4616	1.5231	8	1.6	4.6	3.8	6.2

Figure 14: Averaged objects tab

If a line is double clicked, Automated Registration automatically jumps to all objects tab of the double clicked group and sorts it by internal name.

Automated Registration

9.3 All objects

All objects in the project can be viewed in this tab. Every object group gets an additional mean value.

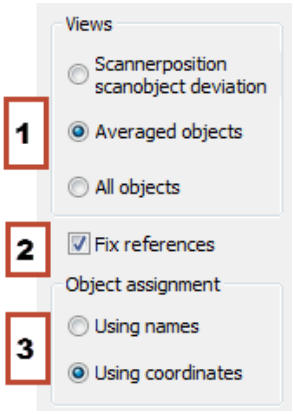
1	Checkbox	use object for calculation
1	Internal name	internal name
2	SCENE name	name in SCENE, where this object is from
3	Scan	object can be found in scan
4	Type	object type
5	x, y, z (m)	object coordinates
6	dx, dy, dz, dR (mm)	object deviation
7	D2S	distance from scanner to object
8	Pts (#)	used points for object detection
9	PS (mm)	point grid size on object in the scan
10	Res	scan resolution

Internal name	SCENE name	Scan	Type	x [m]	y [m]	z [m]	dx [mm]	dy [mm]	dz [mm]	dR [mm]	D2S [m]	Pts [#]	PS [mm]	Res
9000x			_mean_	-13.3251	-28.4278	0.3049	3.1	1.8	0.1	3.6				
9000x	9000x		_Reference_	-13.3220	-28.4260	0.3050								
9000x	9000x	Tuch_000	Sphere	-13.3281	-28.4311	0.3028	6.1	5.1	2.2	8.3	25.2009	49	7.4	1/2
9000x	9000x	Tuch_002	Sphere	-13.3253	-28.4264	0.3068	3.3	0.4	-1.8	3.8	16.5833	508	4.8	1/2
9001x			_mean_	-0.0012	0.0021	0.4482	0.2	-0.1	-0.2	0.3				
9001x	9001x		_Reference_	-0.0010	0.0020	0.4480								
9001x	9001x	Tuch_002	Sphere	-0.0010	0.0035	0.4549	0.0	-1.5	-6.9	7.1	21.7822	311	6.4	1/2
9001x	9001x	Tuch_004	Sphere	-0.0010	0.0024	0.4470	-0.0	-0.4	1.0	1.1	15.9263	129	4.7	1/2
9001x	9001x	Tuch_005	Sphere	-0.0057	0.0004	0.4471	4.7	1.6	0.9	5.1	10.7782	842	3.2	1/2
9001x	9001x	Tuch_007	Sphere	-0.0030	0.0011	0.4461	2.0	0.9	1.9	2.9	15.1649	699	4.4	1/2
9001x	9001x	Tuch_008	Sphere	0.0029	0.0016	0.4443	-3.9	0.4	3.7	5.4	20.7510	316	6.1	1/2
9001x	9001x	Tuch_015	Sphere	0.0007	0.0039	0.4501	-1.7	-1.9	-2.1	3.3	20.8334	353	6.1	1/2
9001xx			_mean_	-0.0016	0.0044	1.1937	0.6	-2.4	4.3	5.0				
9001xx	9001xx		_Reference_	-0.0010	0.0020	1.1980								
9001xx	9001xx	Tuch_038	Sphere	-0.0023	0.0069	1.1895	1.3	-4.9	8.5	9.9	16.3391	563	4.8	1/2
9002x			_mean_	8.0798	18.6277	0.3464	6.2	1.3	0.6	6.4				
9002x	9002x		_Reference_	8.0860	18.6290	0.3470								

Figure 15: All Objects Tab

Double clicking a scan switches Automated Registration to scan position tab. Every further double click will show the averaged object tab.

9.4 Settings / additional functions



(a) Settings

1 meter			1 meter
1 cm			0.001 meter
1 mm			0.0001 meter
1 yard	3ft	36 inch	0.9144 meter
1 foot		12 inch	0.3048 meter
1 inch			0.0254 meter
1 yard US	3ft US	36 inch US	3600/3937 meter
1 foot US		12 inch US	1200/3937 meter
1 inch US			100/3937 meter

(b) basis of calculation

Figure 16

1. Tab selection

   switching between Automated Registration types

2. Fix references

   If checkbox is set, all devialtions will be calculated to the reference values (if existing)/ if unchecked, deviations will be calculated according to the mean values.

3. Using names/coordinates for object assignment

   There are two means of object assignment: either with objects or with object coordinates. Object names must be assigned correctly. If they are not correct, assignment using coordinates should be used instead.

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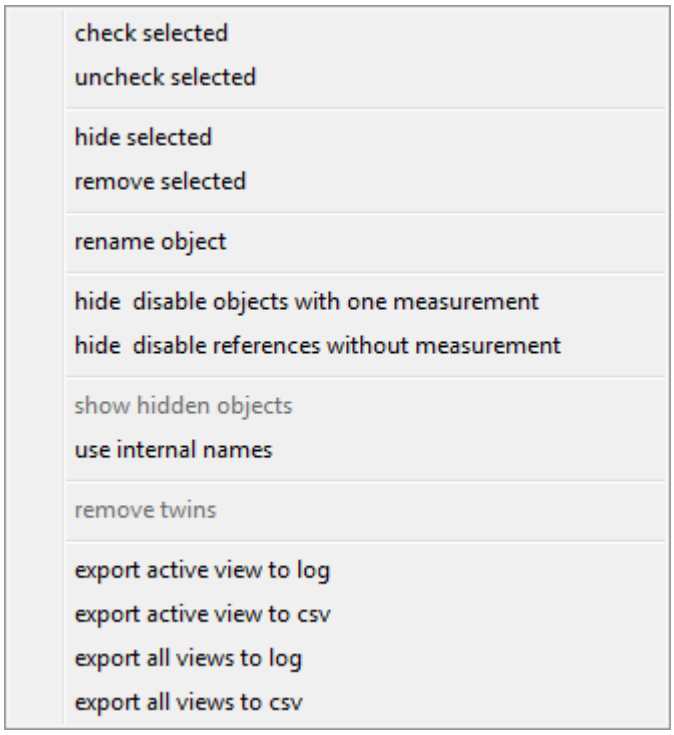

Figure 17: Additional functions

Additional functions can be reached by right clicking in the Automated Registration.

- check selected
  selected objects will be checked and enabled[1]
- uncheck selected
  selected objects will be unchecked and deactivated[1]
- hide selected
  selected objects will be hidden and excluded from calculations;
  the "show hidden objects" function makes them visible[2]
- remove selected
  selected objects will be removed and excluded from calculations;
  objects will also be removed from SCENE if changes are assigned[1]
- rename object
  object groups can be renamed easily[1]

[1] Changes will be applied in SCENE

Automated Registration

- hide & disable objects with one measurment
  objects with only one measurement will be hidden and deactivated[1]
- hide & disable references without measurement
  references in scans without any measurement will be hidden and deactivated[1]
- show hidden objects
  this function makes hidden objects visible, so that they can be used for calculations
- use internal names
  in the case of different names in object groups, Automated Registration can adjust and apply them to SCENE[1]
- remove twins
  if objects are too close or double-marked, Automated Registration will remove them in SCENE[1]
- export active view to log
  exports active view to .txt file
- export active view to .csv
  exports active view to .csv file, for use with Excel
- export all views to log
  exports all views to .txt file
- export all views to .csv
  Exports all views to .csv file, for use with Excel

[1] Changes will be applied in SCENE
[2] Changes will not be applied in SCENE

9.5 Options

1. set unit

   Unit can be selected which will be used in report and export. (Fig. 16b)

2. set limit values

   Deviations from mean or references are marked in different colors. Limits can be set seperatly for each axis.

3. object search radius

   Distance between objects to determine shared identity.
   Search radius will be used, if using coordinates for object assignment is activated.

4. assign options

   - ignore name changes - name changes will be ignored
   - ignore remove status - objects will not be removed

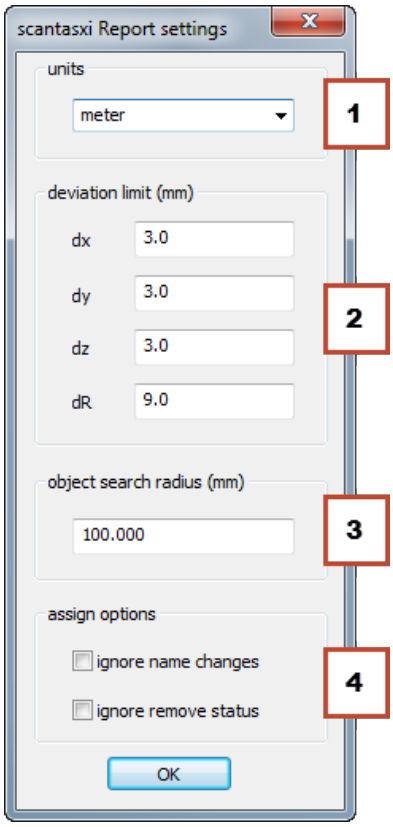

Figure 18: options

10 Known issues

- Unloading the app while running will cause SCENE to crash.
- Registration may take a while - so please be patient. When registration is completed, the dialog will appear.
- Locked Scanmanagers are still ignored (comming with next release)
- Fixed clusters/scans are ignored (comming with next release)

Automated Registration

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