FARO SCENE Guide

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Lesson 1:
The SCENE Interface

This lesson introduces you to SCENE, including basic interface elements, file structure, common icons, and more. The more familiar you are with SCENE, the more efficiently you can work with scan data and share scan projects with others.

This lesson discusses only the most commonly used elements of the SCENE interface. For more information, refer to the **FARO SCENE v5.4 User Manual**.

To proficiently work with SCENE, you need to be familiar with the following:

- Project locations

- **Project Selection** window

- **Structure** window

- **Structure** window icons

- Menu bar

- Toolbars

- Image area

- Status bar

Project Locations

When you start SCENE for the first time, it prompts you to select a location for your scan project files. This location can be modified at any time using **Tools** > **Options**, then clicking the **Folder** tab.

Project Locations
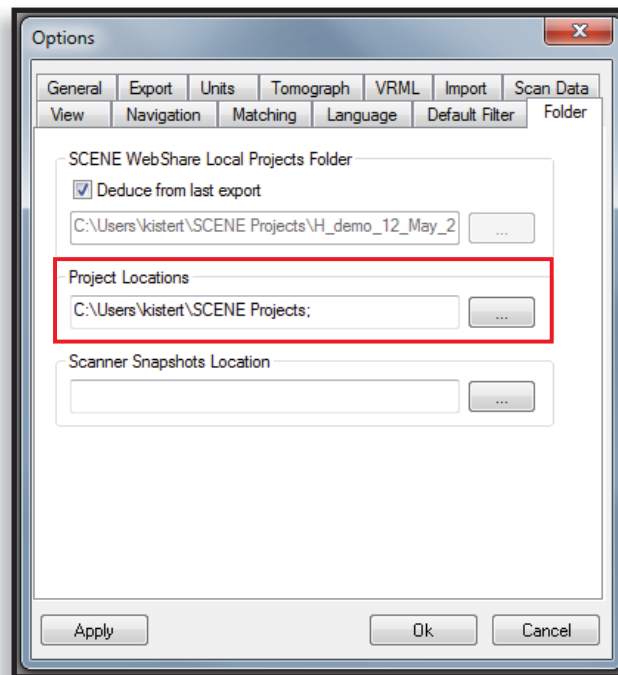
To change the default project location or add additional project locations, click on the browse button next to the **Project Locations** field.
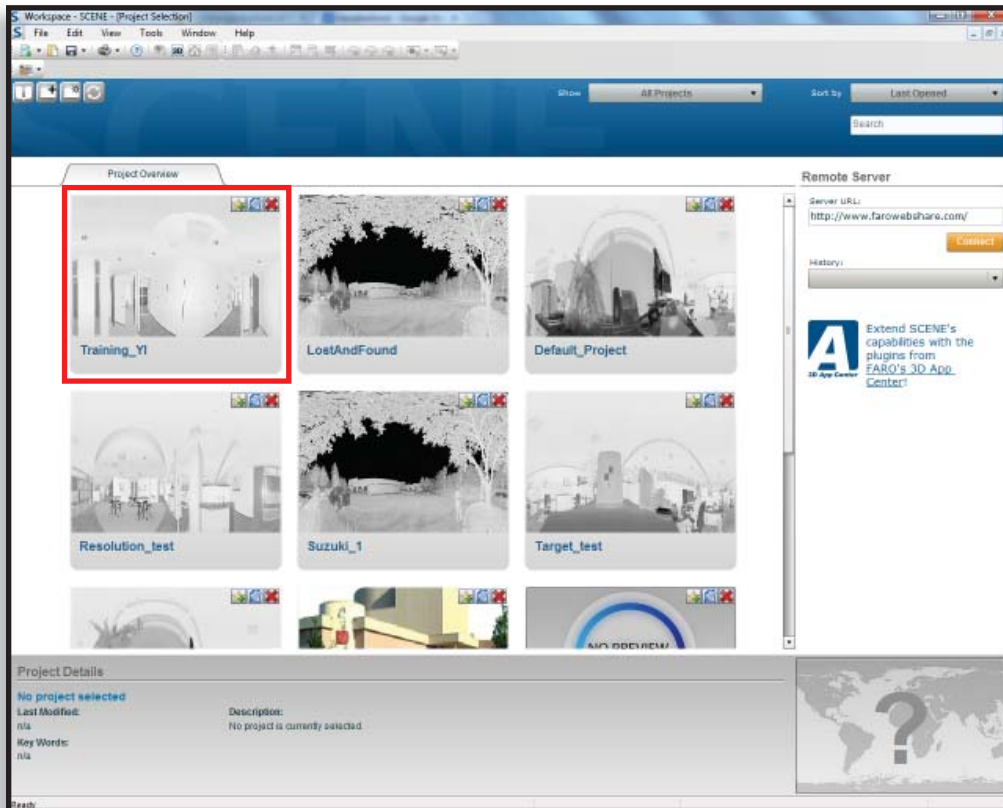
As you use the browse button, the **Project Locations** field is updated to include every location you select (separated by semicolons). SCENE displays all projects from each location in the **Project Selection** window.

Project Selection Window

After you have created the project location, the **Project Selection** window opens.
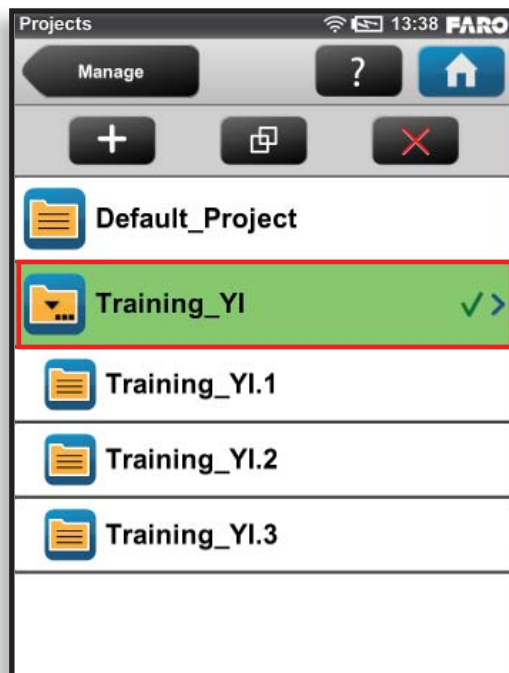
Scan Project in SCENE

The main feature of the **Project Selection** window is the **Project Overview**, which contains previews of the highest-level projects created on the scanner.

To open a scan project, double-click on the project preview or click on the project preview and select from the menu that appears.

Scan Project on the Scanner

Editing Project Details

You can change the information related to each project in the Project Selection window by clicking Edit Project Information in the upper right hand corner of each project preview

Project Details Dialog Box

Typical SCENE Layout

After opening a scan project, the typical SCENE layout appears.

Typical SCENE Layout
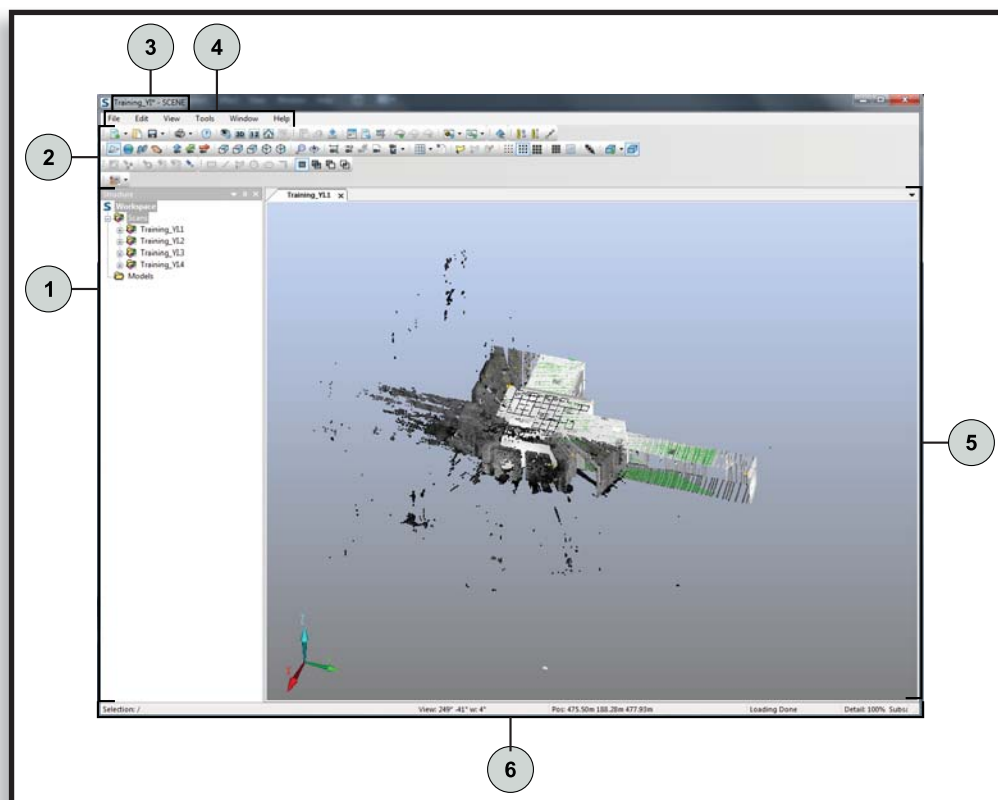
The basic elements of the typical SCENE layout are:

1. **Structure** window
2. Toolbars
3. Project name
4. Menu bar
5. Image area
6. Status bar

Menu Bar

The menu bar contains menus with various submenus and commands.

Menu Bar
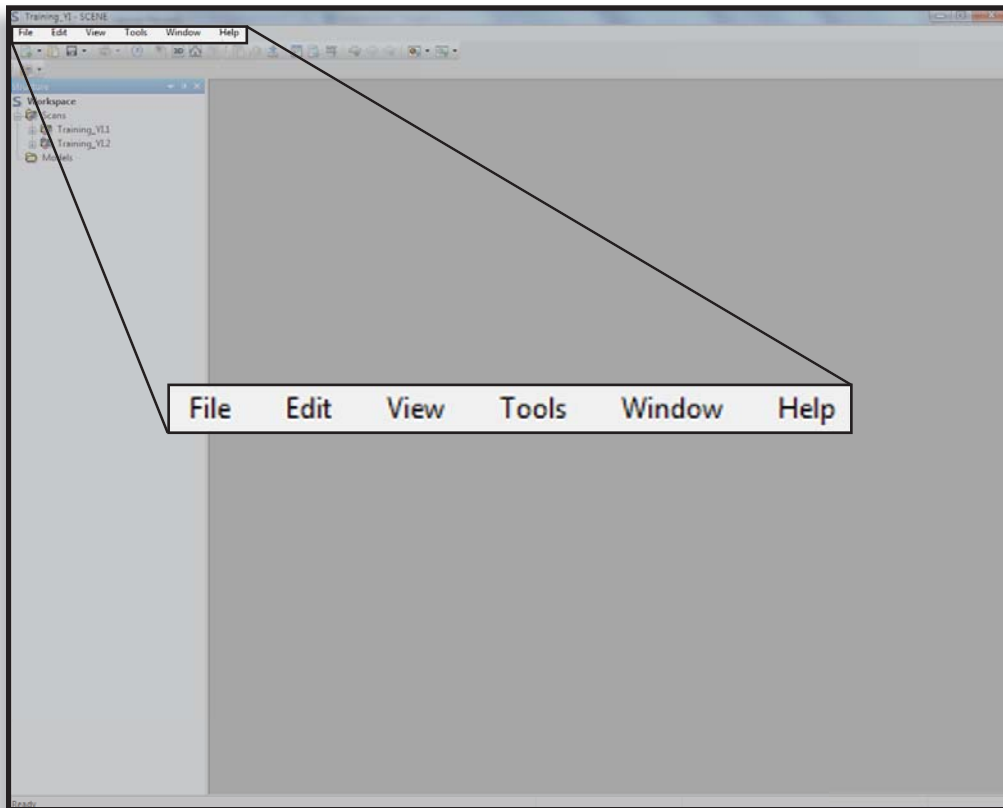
Toolbars

There are several toolbars in SCENE. Most toolbars open automatically with each of the different views. You can also display or hide toolbars using the **View** menu.

View Menu – Toolbars
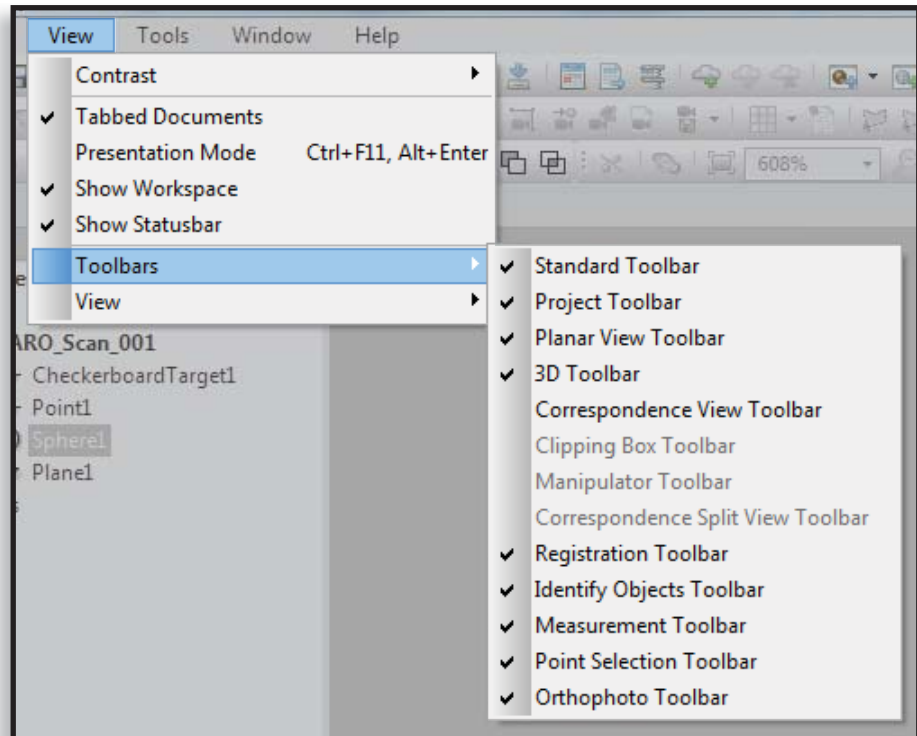
When you first open SCENE, three toolbars appear:

- **Standard Toolbar**

- **Project Toolbar**

- **Orthophoto Toolbar**

Toolbars
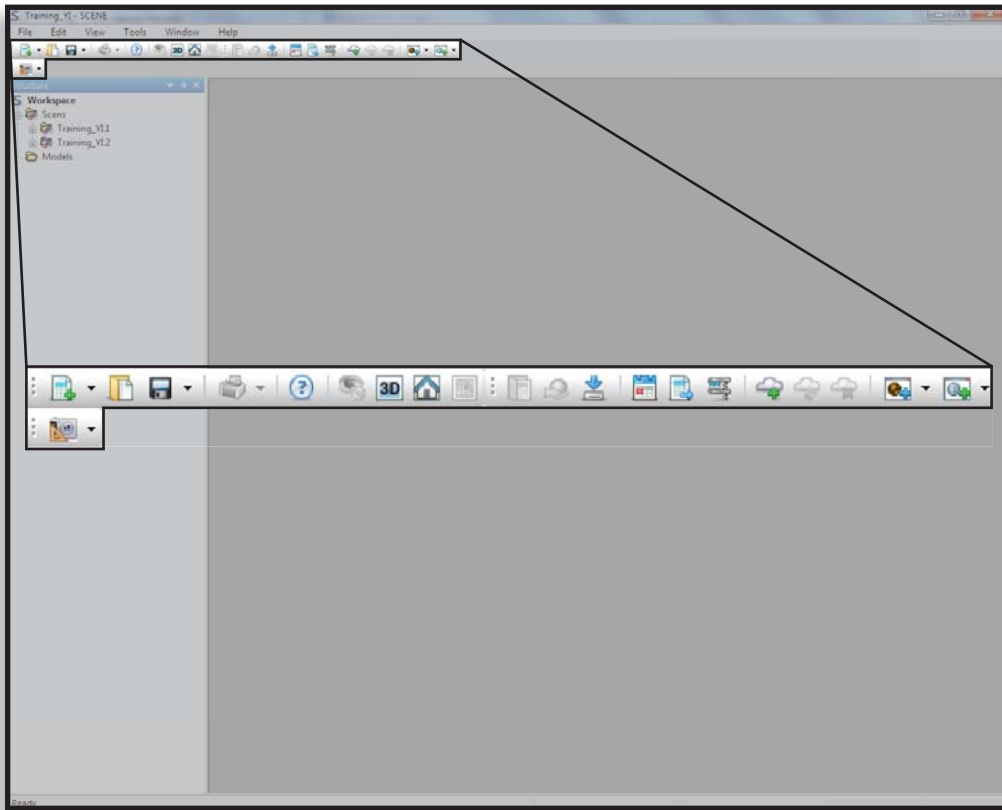
Structure Window

The **Structure** window displays the file structure created on the scanner, the scans, and other data contained in the scan project.

Other data can include:

- Pictures

- Measurements

- CAD models

- Clipping Boxes

The subprojects that you created on the scanner are displayed in the **Structure** window as clusters, which are folders that contain scans.

Structure Window
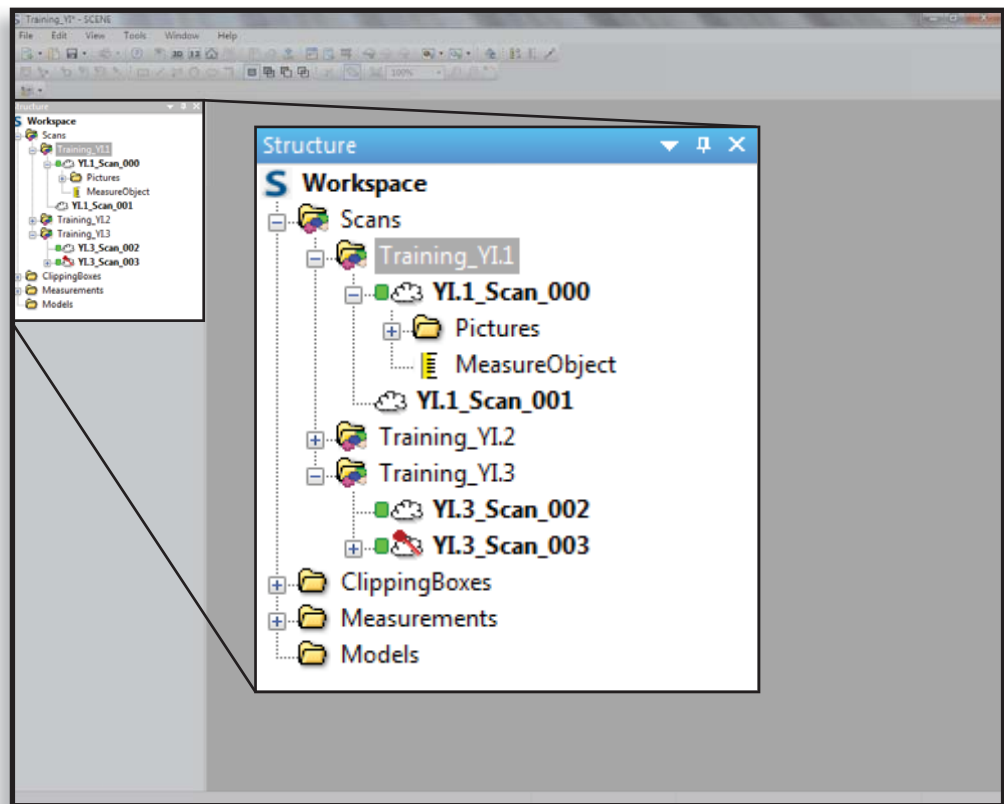
SCENE File Structure

When you first open the scan project in SCENE, if you expand the clusters, only the scans are visible.

SCENE File Structure
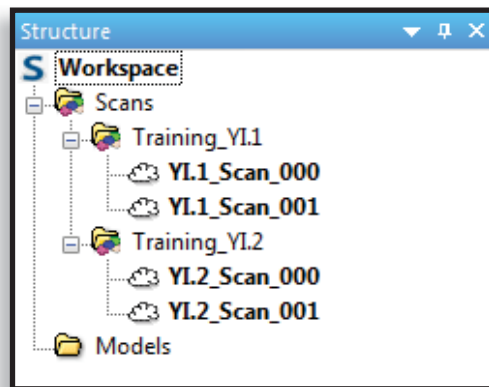
As you work with the project, additional elements become visible in the **Structure** window.

SCENE File Structure Elements
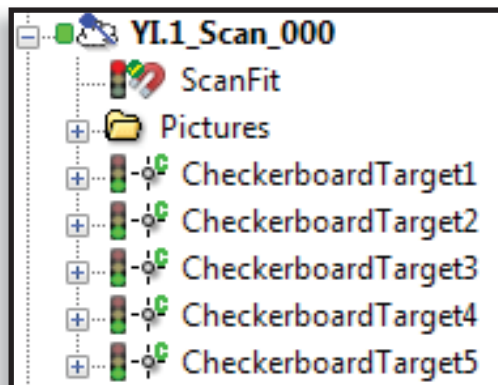
The highest-level folder that you created on the scanner appears in the **Structure** window as the folder **Scans**.

Project on the Scanner
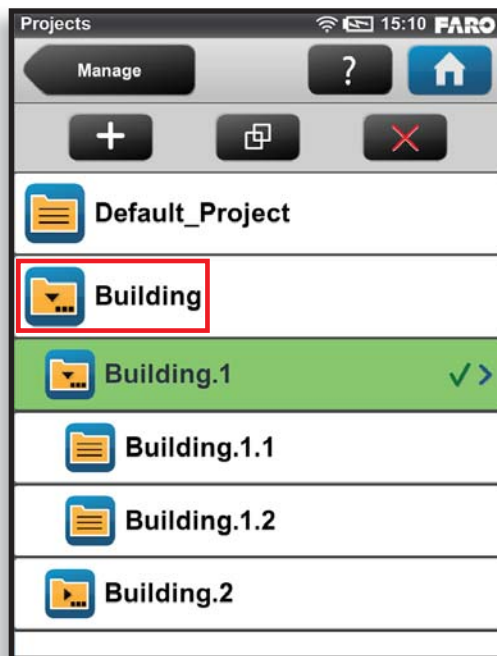
Project in SCENE
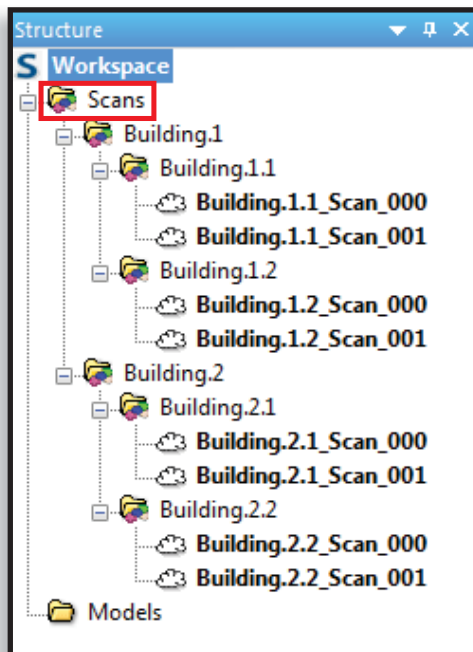
SCENE automatically creates additional files and folders, such as **Models**, **Pictures**, and **ScanManager**, depending on the actions you perform and the data in the project.

Icons in the Structure Window

Several icons are used in the **Structure** window as you work with scan data.

SCENE combines several small icons for each element. Each small icon provides additional information. For example, the icon that indicates an element has a good, active fit is composed of a traffic light icon, a check mark icon, and a magnet icon.

Icon Example

The following table includes many of the icons that appear in the **Structure** window.

Icons in the Structure Window

Icon	Meaning
Folders	
	Cluster
	Fixed Cluster
	Reference Cluster
	Folder
	Mesh Folder
Scans	
	Scan
	Scan with Scan Point Cloud
	Modified Scan
	Reference Scan

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Icon	Meaning
	Fixed Scan
	Loading Scan
	Loaded Scan
	Reduced-Size Loaded Scan
Registration/Correspondence Status	
	Good
	Medium
	Poor
	Active
	Inactive
Correspondences	
	Automatic Correspondence
	Ignored Correspondence
	Forced Correspondence
Objects	
	Checkerboard
	Circular, Flat Target
	Contrast Mean Point
	Document
	Expanded Plane
	Line
	Mean Point
	Mesh
	Pipe
	Plane

Icon	Meaning
	Point
	Region
	Scan Point
	Slab
	Sphere
	Sphere Radius
Miscellaneous	
G	Global Origin
?	Missing Element
	Picture
	Viewpoint
	Virtual Scan (High-Resolution, Imported Picture)

Shortcut Menus

Most actions in SCENE are performed using shortcut (right-click) menus in the **Structure** window.

Shortcut Menu
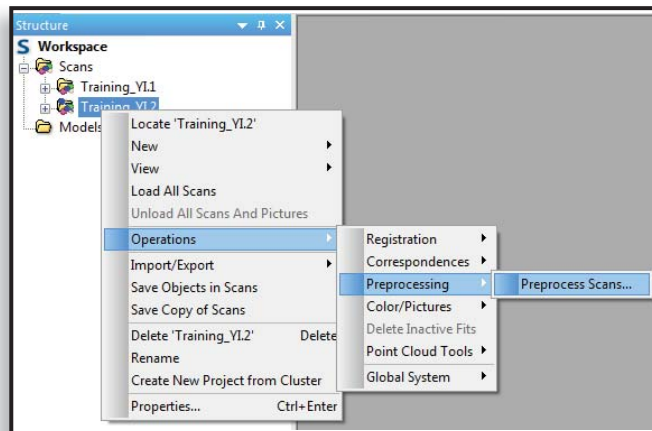
Image Area

The scans display in the image area. The type of visualization depends on the type of view selected.

Image Area
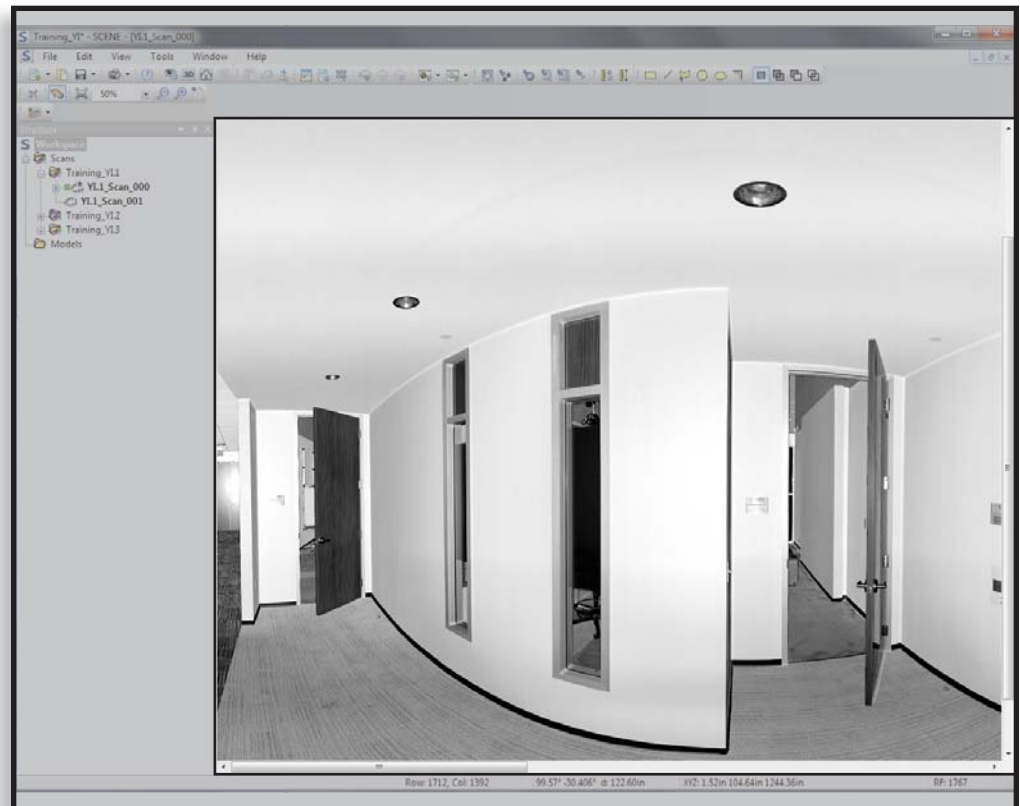
You can view scans in the image area using tabs, which display names along the top of the image area, or without tabs. To switch this feature on and off, in the menu bar, click **View** > **Tabbed Documents**.

When using tabs, you can arrange scans within the image area.

To arrange scans, in the menu bar, turn **Tabbed Documents** off, then click **Window**, then click:

- **Cascade**

- **Tile Horizontally**

- **Tile Vertically**

Views

SCENE displays scan data in five different views within the image area:

- **Quick View** – Provides a view of a single scan from the perspective of the scanner.

- **3D View** – Provides a view of a scan or cluster. A single scan is shown from the perspective of the scanner. A cluster is shown as an isometric projection.

- **Planar View** – Provides a flattened view of a single scan.

- **Correspondence View** – Provides a view of a cluster from the perspective of the scanner. **Correspondence View** allows you to reposition scans.

- **Correspondence Split View** – Provides views of two scans, each in a separate window, from the perspective of the scanner.

The two views used most during this training are **3D View** and **Correspondence Split View**. These views will be discussed in detail later in the training.

There are other views in SCENE and in the user manual (**Structure View**, **Administration View**, **Layout View**, **3D Clear View**, and **SCENE WebShare View**). These, however, are not discrete views used for visualizing scan data.

Troubleshooting

When you open a view, the name of the window (usually the name of the scan or cluster) is displayed at the top of the window. If you maximize the window, the name is displayed above the menu bar.

The names displayed at the top of the view windows vary, depending on what type of view you have open and how you opened the view. For example, if you open **3D View** by right-clicking on a scan in the **Structure** window, the name of the scan will be displayed at the top of the window; however, if you open the same scan using another method, the name at the top of the window will be **Workspace**.

Status Bar

The information displayed in the status bar depends on what you have selected, where the cursor is, and what view you have open.

The type of information displayed in the status bar includes:

- Operation status

- Tooltips

- Location and reflectivity of scan points

Status Bar
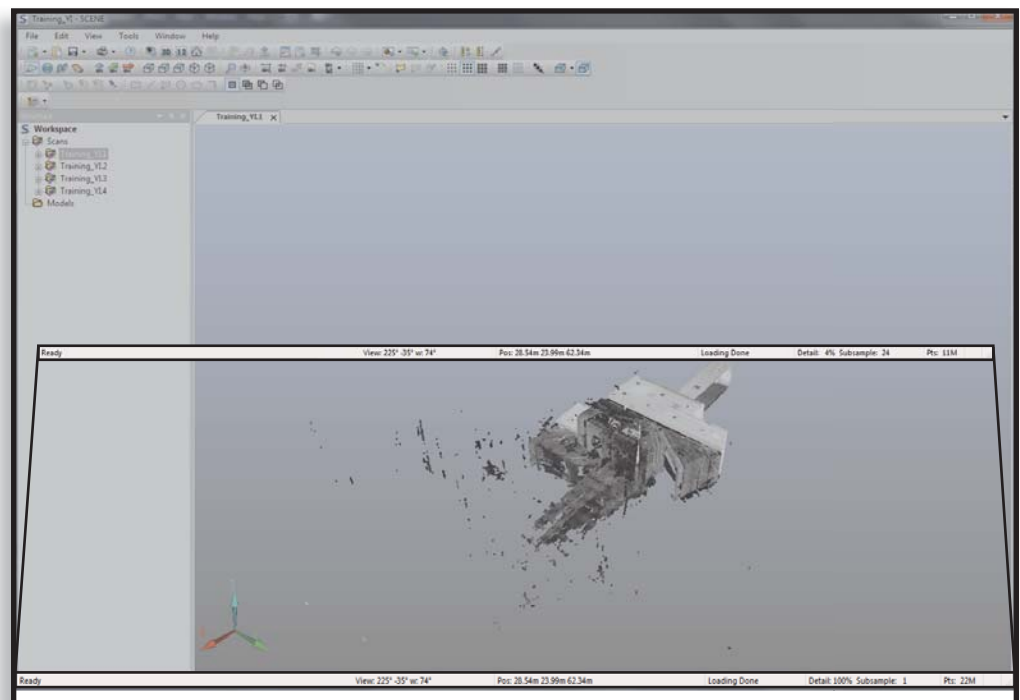
Scan State

The term scan state refers to whether scans have been loaded or unloaded, and whether or not scan point clouds have been created. These two states affect your ability to view scan data and the types of operations you can perform in SCENE.

Loaded vs. Unloaded

To perform certain processes, SCENE loads scan data into your computer's RAM. This is either done automatically as part of a SCENE process, or manually. This feature is designed to reduce memory use and increase the efficiency of SCENE. Loading scans can take several minutes.

To load and unload scans:

In the **Structure** window, right-click on a scan, multiple individual scans, or a scan cluster, and click either **Load All Scans** or **Unload All Scans and Pictures** (for a cluster), or **Loaded** (for individual scans).

Scan Point Clouds

ASTM defines a point cloud as "a collection of data points in 3D space (frequently in the hundreds of thousands)."[1]

A point cloud is also defined as "the computer visualization of the XYZ coordinates that describe a physical object or environment. Each point represents an actual point on the object or in the environment, and collectively describes its shape and measurement... Synonymous with raw scan data."[2]

When you use the **Create Scan Point Clouds** or **Create Scan Point Cloud** commands in SCENE, the process is not related to visualizing the point cloud; rather, it is related to back-end processing of scan data.

Several SCENE functions require this process. In many cases, such as during **Preprocessing**, this process is automatic. However, you may need to manually create scan point clouds to perform some operations, such as creating clipping boxes in **3D View**.

To create scan point clouds, in the **Structure** window, right-click on a cluster or a scan, and click **Operations** > **Point Cloud Butto**ns > **Create**

[1]ASTM International, Standard Terminology for Three-Dimensional (3D) Imaging Systems. Publication No. E2544-11a
[2]3DScanCo, 3D Scanning Glossary. Accessed 2014-04-14. http://www.3dscanco.com/about/3d-scanning/glossary.cfm#p. Permission to use granted 2014-04-15.

Scan Point Clouds (for a cluster) or **Create Scan Point Cloud** (for a scan).

To delete scan point clouds, in the **Structure** window, right-click on a cluster or a scan, and click **Operations** > **Point Cloud Tools** > **Delete Scan Point Clouds** (for a cluster) or **Delete Scan Point Cloud** (for a scan).

Troubleshooting

SCENE does not always show the scan point cloud icon in the **Structure** window when a scan point cloud has been created. To find out if a scan point cloud has been created, in the **Structure** window, click **Operations** > **Point Cloud Tools**, and, if **Delete Scan Point Cloud** is the active command, then a scan point cloud has been created.

Lesson 2:
Getting Started

If you are opening SCENE for the first time, you are prompted to select a default project location before you can continue. Your instructor will guide you through this process

After opening SCENE and importing scan data, there are several **Options** you can customize. This lesson discusses only the most commonly used **Options**.

To set SCENE **Options**, in the menu bar, click **Tools** > **Options**.

Options Dialog Box
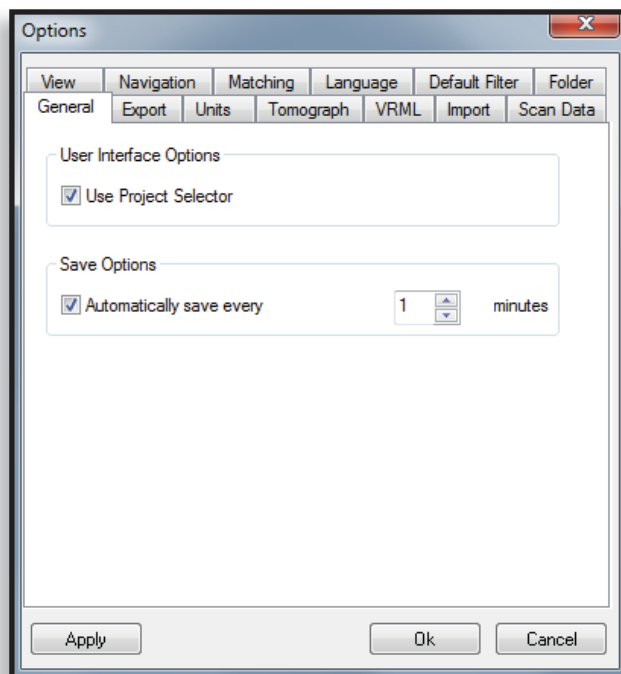
Typically, you will work with the following **Options** tabs:

- **Navigation**

- **Matching**

- **Folder**

- **General**

- **Units**

For more information on the other **Options** tabs, see the **FARO SCENE v5.4 User Manual**.

Navigation Tab

On the **Navigation** tab, you may want to select **Invert Mouse Wheel**. With the default setting, rolling your mouse wheel forward causes the view to zoom out, which is atypical.

Navigation Tab
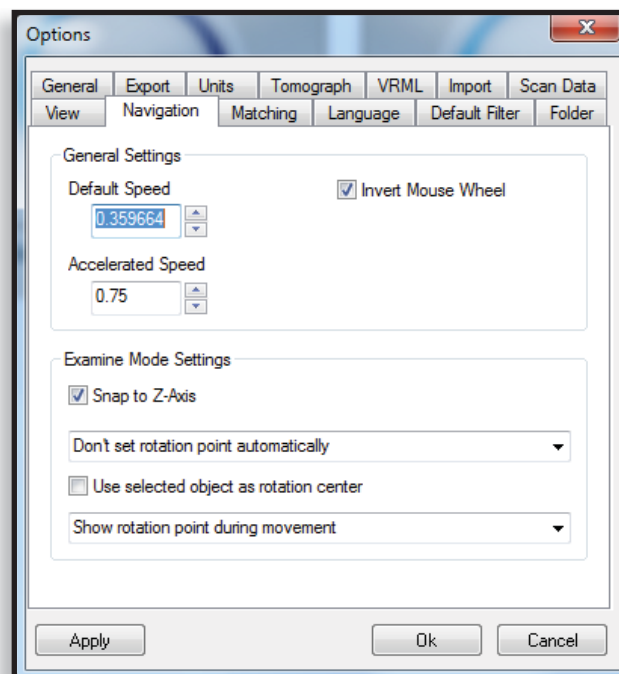
Matching Tab

On the **Matching** tab, there are several settings, including:

- **Place Scan Settings**

- **Expand Plane Settings**

- **Match Sphere Settings**

- **Colorize Settings**

Matching Tab
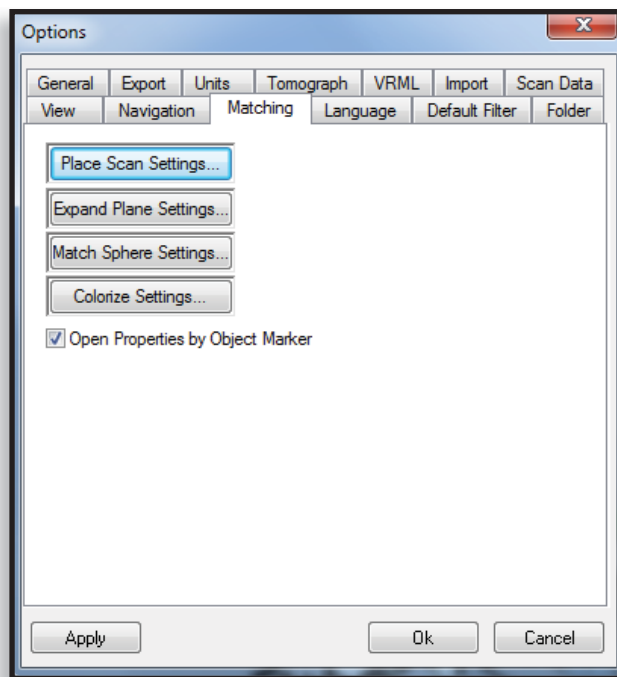
Clicking the **Place Scan Settings** button opens the **Default Place Scan Settings** dialog box, which allows you to select a default registration configuration and associated settings.

Place Scan Settings...

Registration configurations will be discussed later in the training.

Default Place Scan Settings Dialog Box
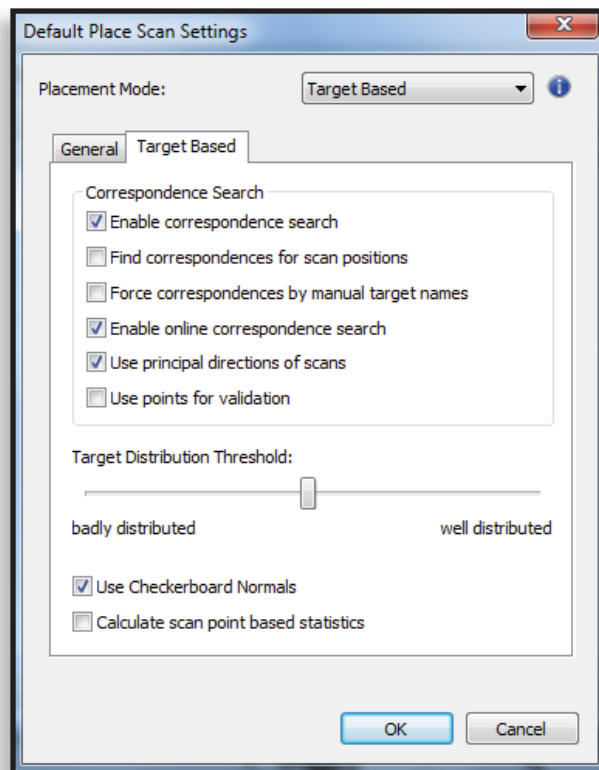
Clicking the **Match Sphere Settings** button opens the **Match Sphere Settings** dialog box, which allows you to customize which sizes of spheres SCENE automatically detects.

Match Sphere Settings...

You can enter multiple sizes on separate lines. To return to the default predefined sphere size, click the **Defaults** button.
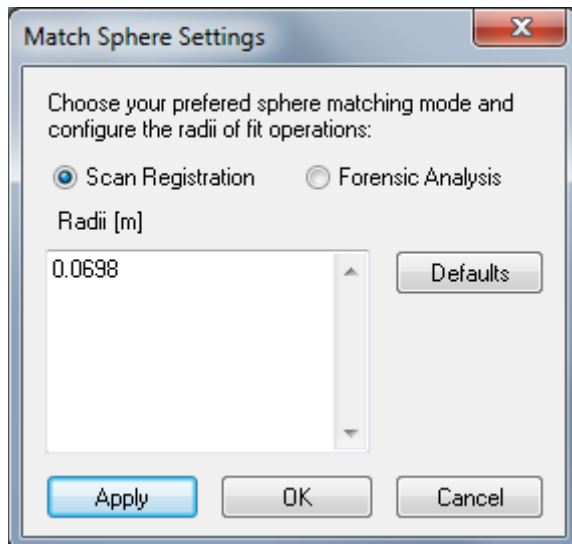
Folder Tab

On the **Folder** tab, you can change the default locations of scan projects (in the **Project Locations** field).

Folder Tab
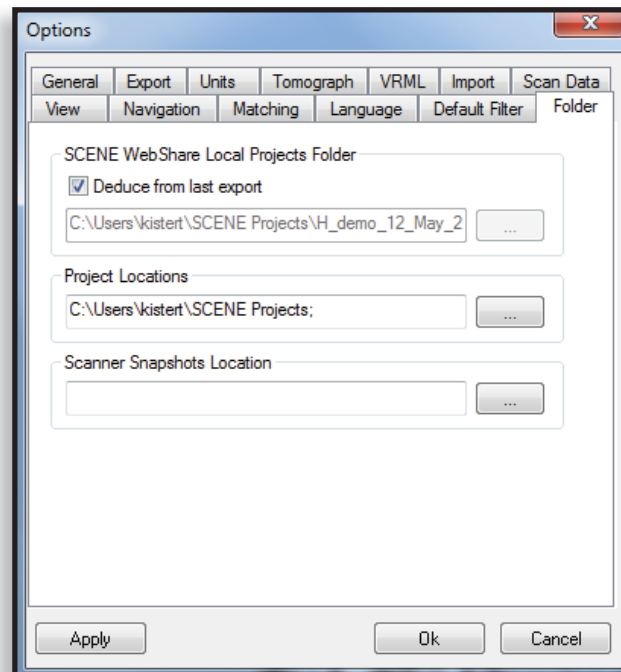
General Tab

On the **General** tab, you can turn on automatic saving, and adjust how often SCENE automatically saves.

General Tab
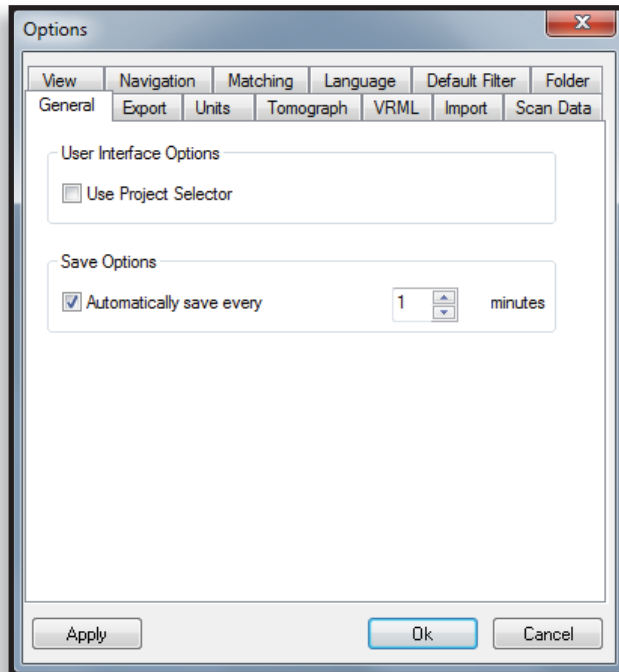
Units Tab

On the **Units** tab, you can change the units that are displayed. All units are displayed using decimals.

Units Tab

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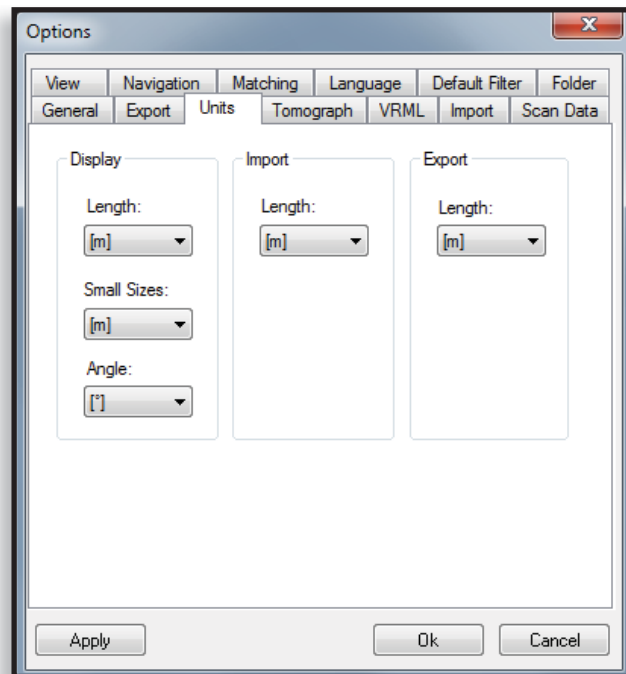
Module Summary

This module introduced you to SCENE.

You should now be able to:

- Identify the basic elements of the SCENE interface.

- Set SCENE **Options**.

Module 4: Basic SCENE Workflow

This module introduces the Basic SCENE Workflow, which includes the general steps for working with scan projects in SCENE.

Understanding the Basic SCENE Workflow allows you to work efficiently in SCENE and choose which steps you need to import, register, refine, and share your scan project.

This module contains one lesson:

- Lesson 1: Basic SCENE Workflow

Lesson 1:
Basic SCENE Workflow

Understanding the typical steps of the Basic SCENE Workflow allows you to work efficiently in SCENE and choose which operations are best suited to your scan projects.

This lesson explains step 1, and the next module explains step 2. The training then returns to the Basic SCENE Workflow and the remaining steps.

It is important to remember that the Basic SCENE Workflow is rarely linear; some steps are not always necessary, and some steps may need to be repeated to ensure the registration is accurate and within your tolerance for error.

The general steps in the Basic SCENE Workflow are:

1. Import scan data and open the scan project.
2. Register.
3. Inspect the registration.
4. Refine the registration.
5. Prepare for exporting.
6. Export.

Basic SCENE Workflow

1. Import scan data and open the scan project.

Insert the SD card.

Open the scan project.

2. Register.

Register automatically (preprocess).

Register manually (identify objects).

Save.

3. Inspect the registration.

Inspect using 3D View.

Inspect using the ScanManager.

Use clipping boxes, as needed.

4. Refine the registration.

Remove correspondences with the highest tension values.

Update the ScanManager.

Repeat as needed.

Save.

5. Prepare for exporting.

Adjust the alignment.

Create a project point cloud.

Crop scan data.

Create clipping boxes.

Apply color information.

Adjust the Visibility Settings.

6. Export.

Importing Scan Data

After you insert the SD card into the computer, you are prompted to transfer data automatically. This is the recommended method for importing a scan project.

SCENE (Import) Dialog Box
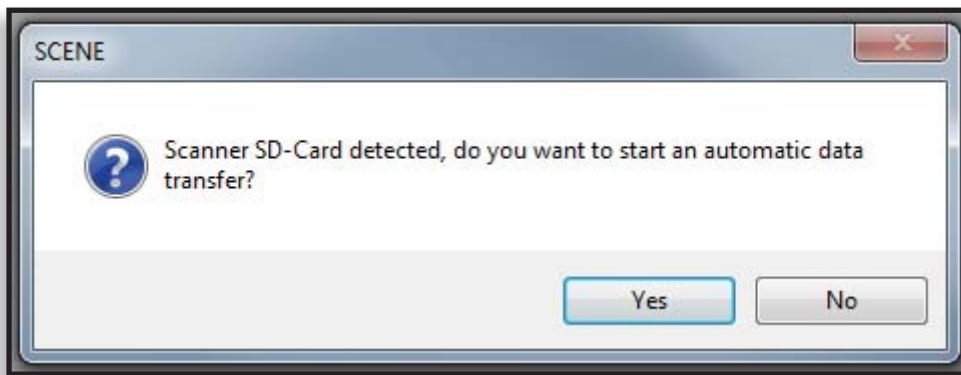
SCENE imports all projects from the scanner, including the **Default_ Project**.

If you have created a scan project and imported the scans into SCENE, you can add additional scans to the project on the SD card. SCENE will automatically import the new scans into the existing project

Note: Imported files must include **LogFiles, RawScans, Revisions, WorkspaceData,*preview.jpg,** *ProjectName***.Isproj,** and **ScanProject. fpr**. These import automatically, but if copying or troubleshooting a project, make sure these folders are included.

> **Troubleshooting**
>
> To import new scan data into an existing project, the project must be closed in SCENE. To close a project in SCENE, click **File** > **Close**. If you have created a new project that has the same name as a project already in SCENE, then SCENE automatically renames both projects to keep them separate.
>
> Building [Building]
>
> Building [Building_2]
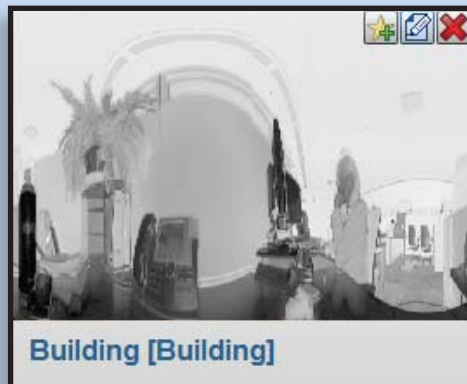
Opening a Scan Project

There are several ways to open an existing project. The simplest way to open a project is to double-click on the project preview in the Project Selection window.

After you open the scan project, the file structure is displayed in the **Structure** window.

Module Summary

This module introduced you to the Basic SCENE Workflow

You should now be able to:

- Identify the Basic SCENE Workflow steps.

- Import scan data.

- Open a scan project.

Module 5: Registration Workflows

This module explains steps 2 and 3 of the Basic SCENE Workflow, which are registration and inspection.

There are two basic registration workflows (Automatic Registration Workflow and Manual Registration Workflow), which include the general steps for registering scans. After registration, it is important to inspect the registration to see if the results comply with your tolerance for error and the project requirements. You can use the inspection results to decide which steps to take next.

This module contains three lessons:

- Lesson 1: Automatic Registration Workflow

- Lesson 2: Inspecting the Registration

- Lesson 3: Manual Registration Workflow

Lesson 1: Automatic Registration Workflow

The second step of the Basic SCENE Workflow is registration. This lesson introduces you to automatic registration and the Automatic Registration Workflow steps.

The Automatic Registration Workflow steps are:

1. Select preprocessing settings.

2. Select a registration configuration.

This process is called automatic registration because SCENE performs several operations automatically that can also be performed manually using various other commands. These functions will be discussed in the lesson on the Manual Registration Workflow.

Automatic Registration Workflow

```
┌─────────────────────────────────────────────────────────────────┐
│ 1. Select preprocessing settings.                                │
│                                                                  │
│        ┌──────────────────────────────────────────┐             │
│        │ Click Operations > Preprocessing > Process Scans. │     │
│        └──────────────────────────────────────────┘             │
│                            │                                     │
│        ┌──────────────────────────────────────────────┐         │
│        │ Select which types of common reference object to identify. │ │
│        └──────────────────────────────────────────────┘         │
│                            │                                     │
│                 ┌────────────────────┐                          │
│                 │ Select Place Scans. │                         │
│                 └────────────────────┘                          │
├─────────────────────────────────────────────────────────────────┤
│ 2. Select a registration                                         │
│ configuration.            ┌──────────────────┐                   │
│                           │ Click Configure. │                   │
│                           └──────────────────┘                   │
│            ┌──────────────┬──────────────┬──────────────┐        │
│    ┌──────────────┐  ┌──────────────┐  ┌──────────────┐          │
│    │ Target Based │  │ Top View Based│ │ Cloud to Cloud│          │
│    │ Registration │  │ Registration │  │ Registration │          │
│    └──────────────┘  └──────────────┘  └──────────────┘          │
│                         ┌────────┐                               │
│                         │ Save.  │                               │
│                         └────────┘                               │
└─────────────────────────────────────────────────────────────────┘
```
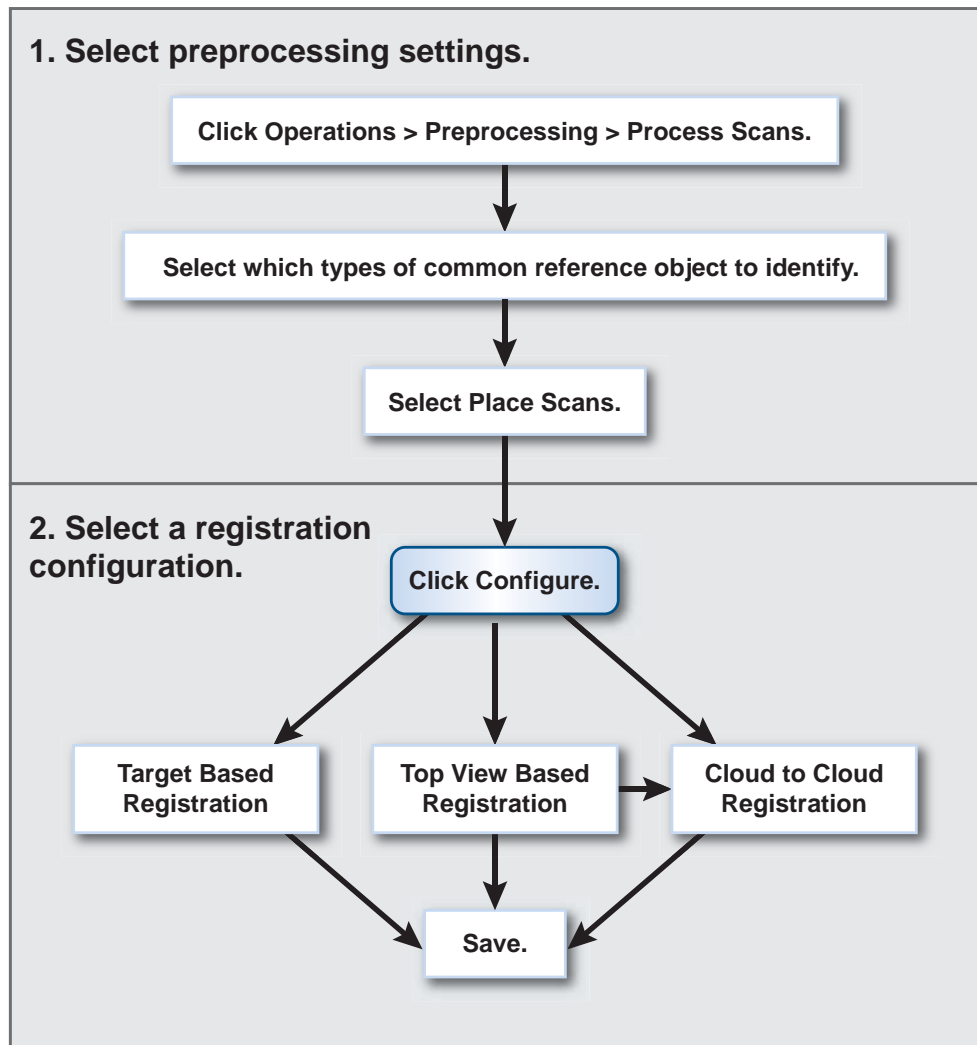
Preprocessing

In SCENE, the term **Preprocessing** refers to a command that allows you perform several batch operations; however, it is best to perform SCENE operations in the general order outlined in this training, which allows you to conserve computer resources and work with scan data more efficiently.

There are several commands you can use to register scans; however this training focuses on using the **Preprocessing** command for all registration processes, because the **Preprocessing** command opens the dialog box that allows you to specify which types of common reference objects to identify.

For an in-depth discussion of the other commands available under the **Preprocessing** command and additional ways to register scans, refer to the **FARO SCENE v5.4 User Manual**.

To use the **Preprocessing** command, in the **Structure** window, right-click on a cluster, then click **Operations** > **Preprocessing** > **Preprocess Scans**.
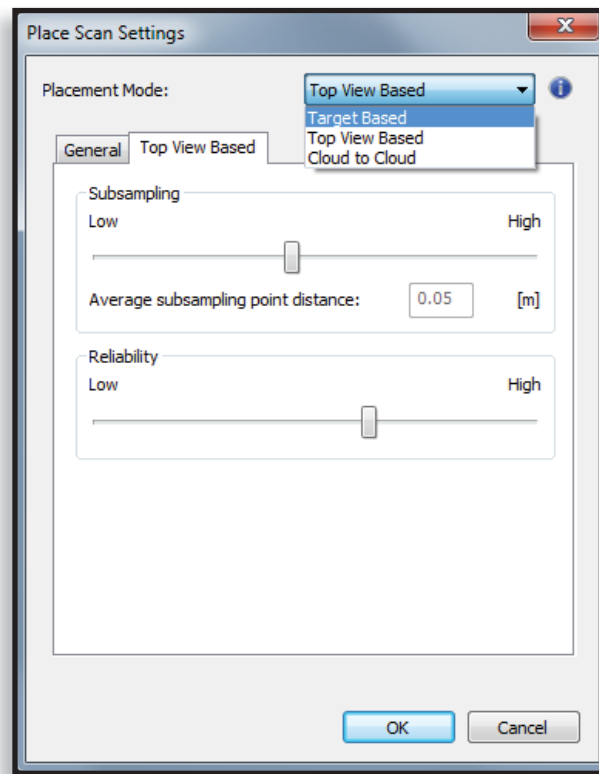
Dialog Box Showing Preprocess Scans Settings
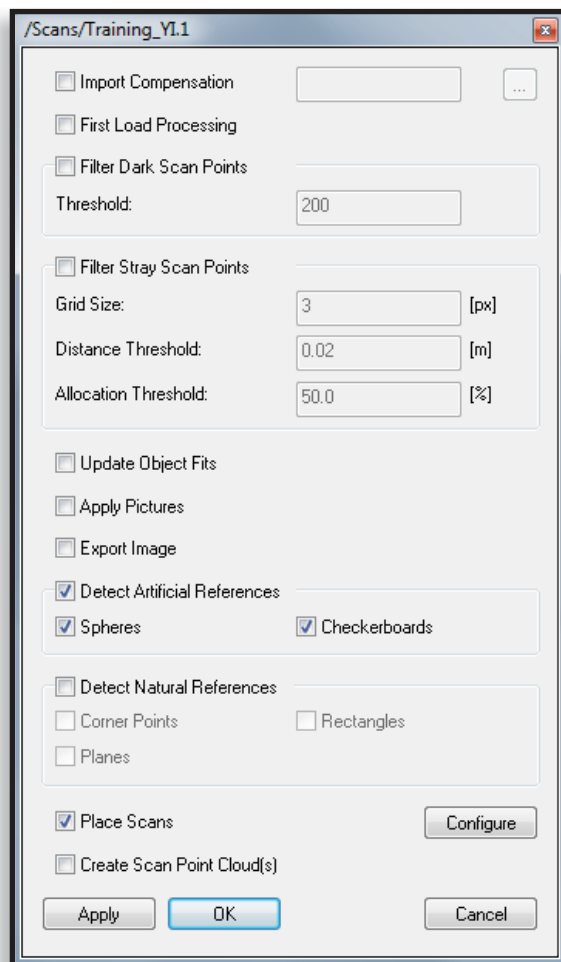
Select **Place Scans** to enable the **Configure** button. Clear all other check boxes.

Click **Configure** to display the **Place Scan Settings** dialog box.

Place Scan Settings Dialog Box

There are two basic types of configuration:

- **Target Based** – This method uses common reference objects to register scans.

- **Targetless** – The targetless methods, which are **Top View Based** and **Cloud to Cloud**, do not use common reference objects to register scans.

In the **Place Scans Settings** dialog box, click on the **Placement Mode** drop-down list to select the type of configuration you want to use.

You can have SCENE find common reference objects for all three configurations; however, common reference objects are only used for registration with **Target Based** registration.

Target Based Registration

With **Target Based** registration, the term **target** in the **Place Scan Settings** dialog box includes both natural and artificial references.

Target Based Registration Settings

**Place Scan Settings Dialog Box – Target Based**
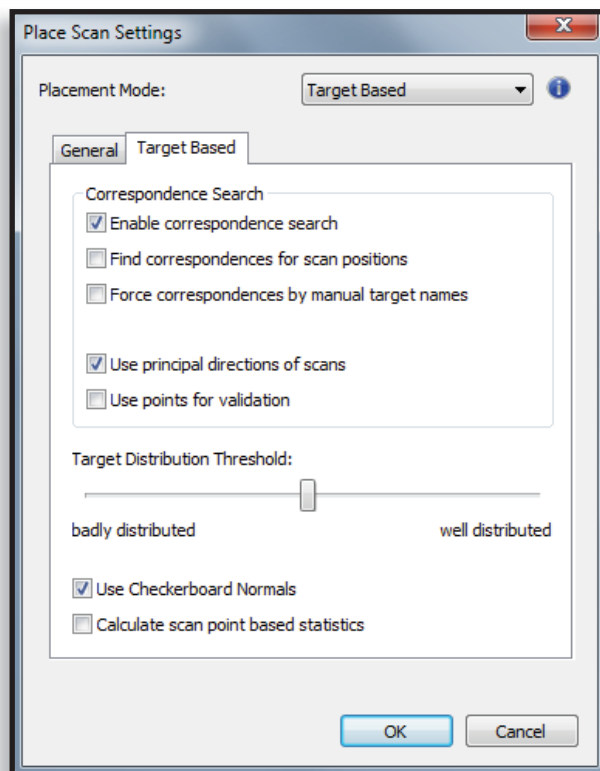
While the default settings are recommended, you can adjust the following settings:

- **Correspondence Search**

  - **Enable correspondence search** – Use to automatically search for correspondences.

  - **Find correspondences for scan positions** – Identifies scanner positions as common reference objects during registration.

- **Force correspondence by manual target names** – Assigns correspondences to common reference objects with matching names. (To use this feature, you must change the **Properties** of each individual reference object, as well as the names of each reference object. (To change the **Properties** so that you can use this feature, in the **Structure** window, right-click on a common reference object, then, on the **General** tab, select either **Use for Place Scans and Correspondence Search** or **Use for Place Scans**.)

Checkerboard Properties Dialog Box
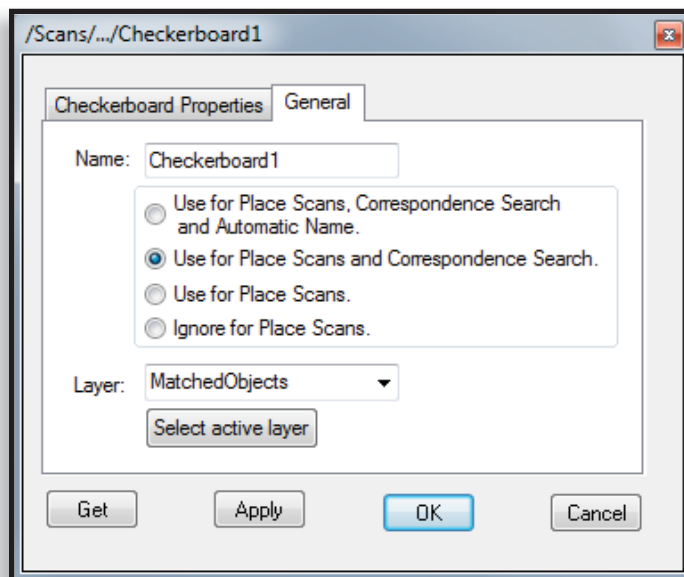
- **Use principal direction of scans** – Uses planes to determine the principal direction of scans during registration. Use for projects that contain perpendicular planes, such as walls and floors in a building.

- **Use points for validation** – Registers with an enhanced validation that compares the relative locations of scan points in each of the scans. Using this feature can cause registration to take much longer.

- **Target Distribution Threshold** – Adjusts the allowed distance between targets used for registration. Move the slider toward **badly distributed** for targets that are close together and toward **well distributed** for targets that are farther apart.

- **Use Checkerboard Normals** – A normal is a vector that is perpendicular to the checkerboard. Clear this check box if you have used checkerboards that have been rotated between scans for precise orientation to each scanner position, or if you have checkerboards that are not completely flat.

- **Calculate scan point based statistics** – Calculates scan-point-based statistics, in addition to target-based statistics. When you use this feature, SCENE includes the scan-point-based statistics in the **ScanManager** on an additional tab called the **Scan Point Tensions** tab.

Targetless Registration

Sensor data is essential when using targetless registration. Always use the inclinometer, and, if you are scanning outdoors and the GPS sensor is available, use that.

Using clusters and the **Lock** command, which is available for each **ScanManager**, is a good practice during targetless registration, because it allows you to work with a small number of scans at once, reducing the amount of computer memory and time required for each registration.

You can take reference measurements and include a few targets in the scan area so you can verify the results of targetless registration.

Top View Based Registration

Top View Based registration works best if there are stationary vertical features, such as walls, in the scan area. Use **Top View Based** registration for indoor projects, or for an initial registration of outdoor projects.

Top View Based registration works best with inclinometer data.

With **Top View Based** registration, SCENE detects the types of common reference objects that you have selected; however, the common reference objects are not used for registration.

If you have selected **Detect Artificial References** or **Detect Natural References** in the first dialog box, SCENE will create **AutoFeatures** folders and find the selected types of objects, but the objects are not used for registration.

Top View Based Registration Settings

Place Scan Settings Dialog Box – Top View Based
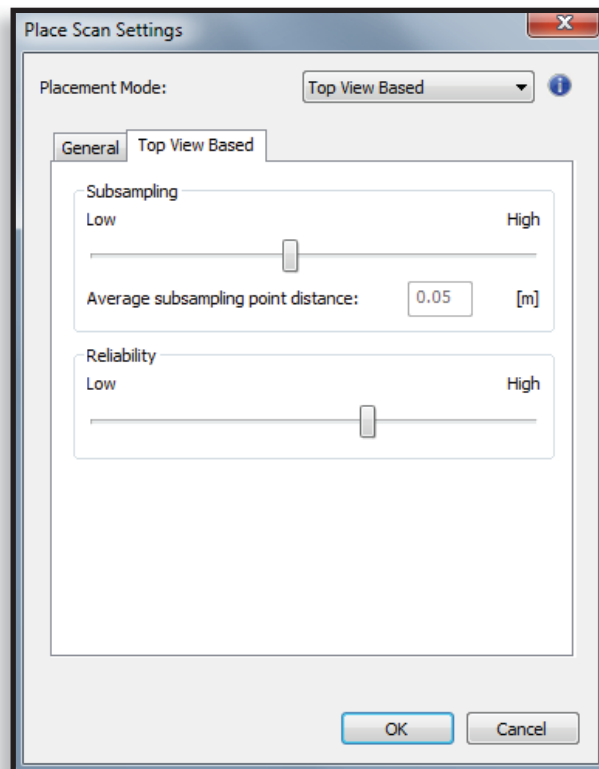
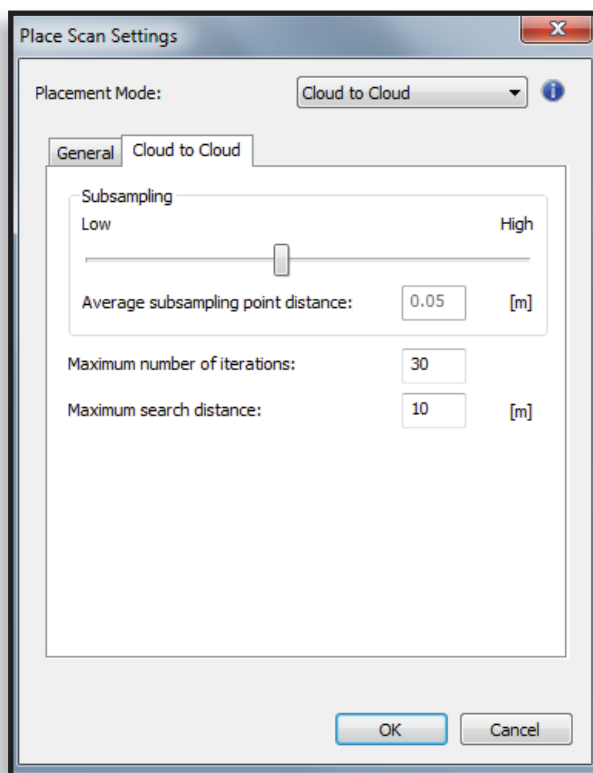While the default settings are recommended, you can adjust the following settings:

- **Subsampling** – Reduces and homogenizes the point density to the specified point distance, which reduces the amount of time required for registration. As you move the slider, the point distance for subsampling is displayed in the **Average subsampling point distance** field. For large point clouds, in which the point distance is larger, move the slider toward **High**. For small point clouds, in which the point distance is smaller, move the slider toward **Low**.

- **Reliability** – Determines the threshold of variance in corresponding scan points. A higher setting increases the probability that corresponding scan points are accurately matched and increases processing time. A lower setting provides less accurate results and decreases processing time.

Cloud to Cloud Registration

When working with **Cloud to Cloud** registration, you may want to first do an initial registration using **Top View Based** registration or using manual placement in **Correspondence View**. (See Module 6 for more information on **Correspondence View**.) Then, **Cloud to Cloud** registration can be used to reduce any remaining error.

Cloud to Cloud Registration Settings

While the default settings are recommended, you can adjust the following settings:

- **Subsampling** – Reduces and homogenizes the point density to the specified point distance, which reduces the amount of time required for registration. As you move the slider, the point distance for subsampling is displayed in the **Average subsampling point distance** field. For large point clouds, in which the point distance is larger, move the slider toward **High**. For small point clouds, in which the point distance is smaller, move the slider toward **Low**.

- **Maximum number of iterations** – Determines the number of times the algorithm will be applied. The higher the number, the more precise the results.

- **Maximum search distance** – Determines the distance from each point within which SCENE searches to find corresponding scan points.

Detecting Common Reference Objects

After configuring preprocessing, click **OK**, then select the types of common reference objects you would like SCENE to detect.

While common reference objects are required for **Target Based** registration, they are not required for **Top View Based** or **Cloud to Cloud** registration; SCENE detects common reference objects and displays them in the **Structure** window, but they are not used for registration.
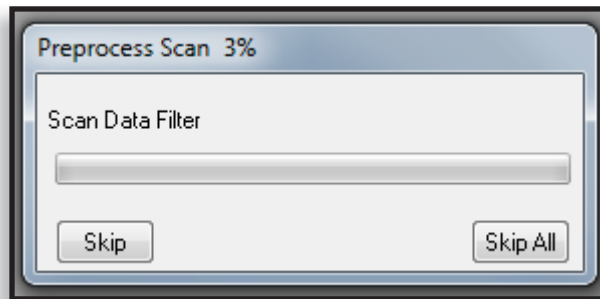
Note: Version 5.4 now allows object detecting in 3D View, as well.

You can select:

- **Detect Artificial References**

  - **Spheres**

  - **Checkerboards**

- **Detect Natural References**

  - **Corner Points**

  - **Rectangles**

  - **Planes**

As SCENE is **Preprocessing** the scans, the **Preprocess Scan** dialog box displays the progress.
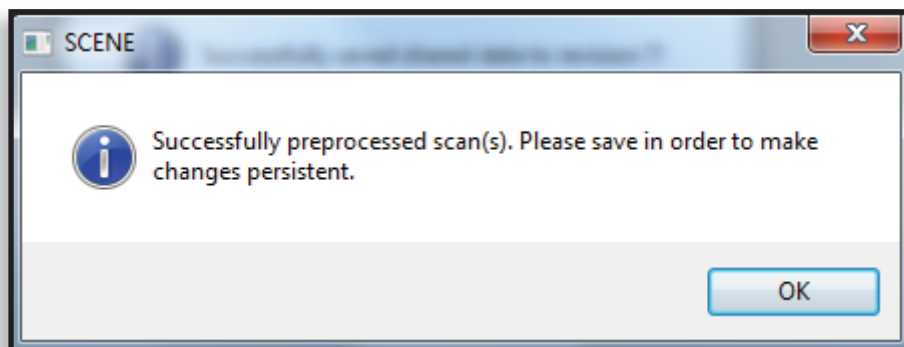
Preprocess Scan Dialog Box

Troubleshooting

Clicking **Skip All** in the **Preprocess Scan** dialog box does not skip all processes; to cancel **Preprocessing**, click **Skip All** several times.
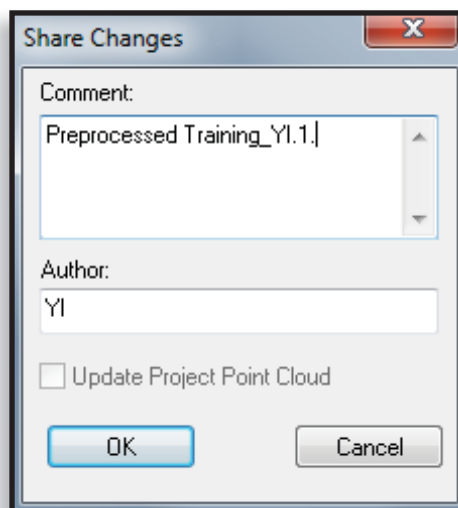
Saving

When **Preprocessing** is complete, you are prompted to save.
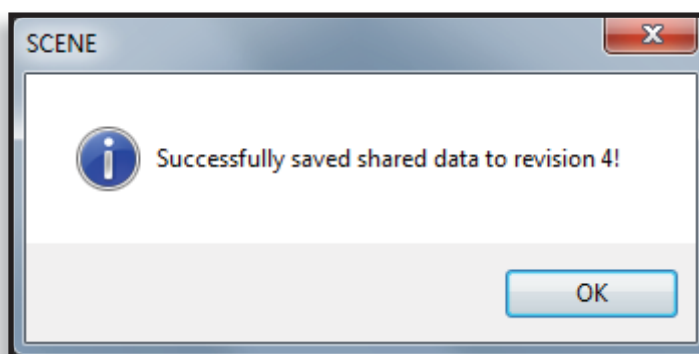
Save Prompt

To save the scan project, click **Save**. The **Share Changes** dialog box appears.

Share Changes Dialog Box

Adding information in the **Comment** and **Author** fields help keep your data organized as you continue to work with the project. When the project has been saved successfully, a message appears.

SCENE Dialog Box

Save often, and save every time SCENE prompts you to save. When a project has been modified, an asterisk appears next to the project name in the upper left corner of the screen.

Modified Project Name
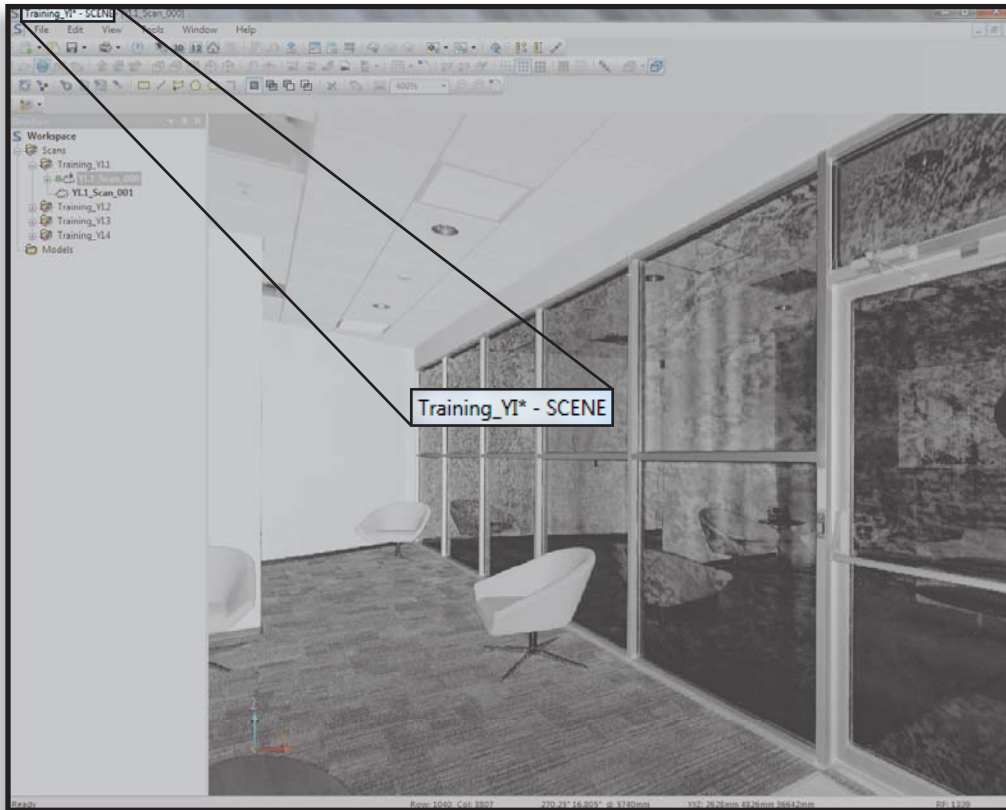
Project History

As you work through the next activities, it is important to understand more about the **Project History**.

When you save your scan project, SCENE creates a new revision, which is stored in the **Project History**.

To view the **Project History**, in the **Project Toolbar**, click the **Project History** button.

In the **Project History,** you can work with a previous revision of a project using either **Revert** or **Load Revision**. You can also export a revision as a new project.

Project History Dialog Box
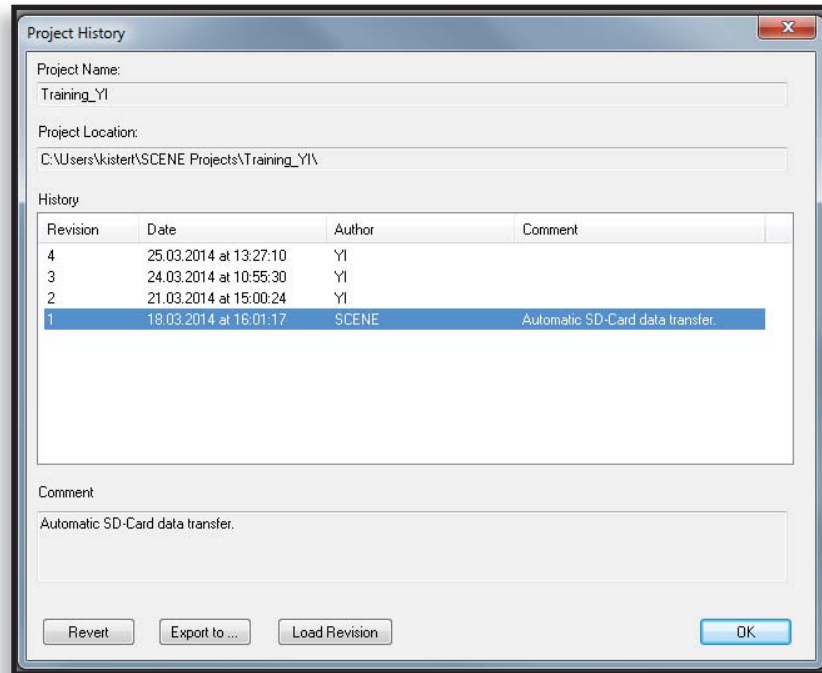
After selecting a Revision in the Project History dialog box, you can:

- **Revert** – Opens the revision and deletes all subsequent revisions.

- **Export to** – Creates a new project with no other revisions.

- **Load Revision** – Opens the revision and does not delete subsequent revisions.

There is an important difference between reverting to a previous revision (**Revert**) and loading a previous revision (**Load Revision**):

- If you use **Revert**, all revisions of the project that were created after the revision you are reverting to are automatically permanently deleted.

- If you use **Load Revision**, you can work with a previous revisions without deleting other saved revisions.

Troubleshooting

Reverting to a previous revision of a project permanently deletes all subsequent revisions.

While there is an option to **Load** a project, which will not delete subsequent revisions, all subsequent revisions will disappear from the **History** list until SCENE has been closed and opened again.

To revert to a previous revision of the scan project:

1.   In the **Project Toolbar**, click the **Project History** button.
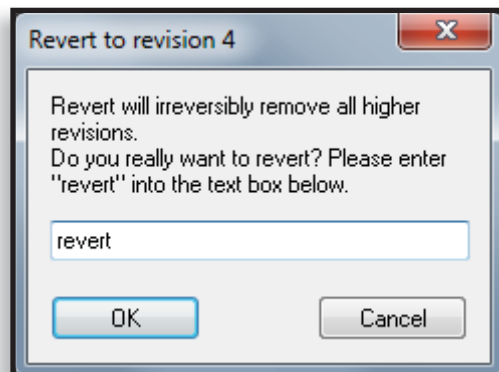

2.   Select the revision you want to work with.

3.   Click **Revert**.

     You may be prompted to save.

4.   The **Revert to revision [x]** dialog box appears, asking if you really want to revert.

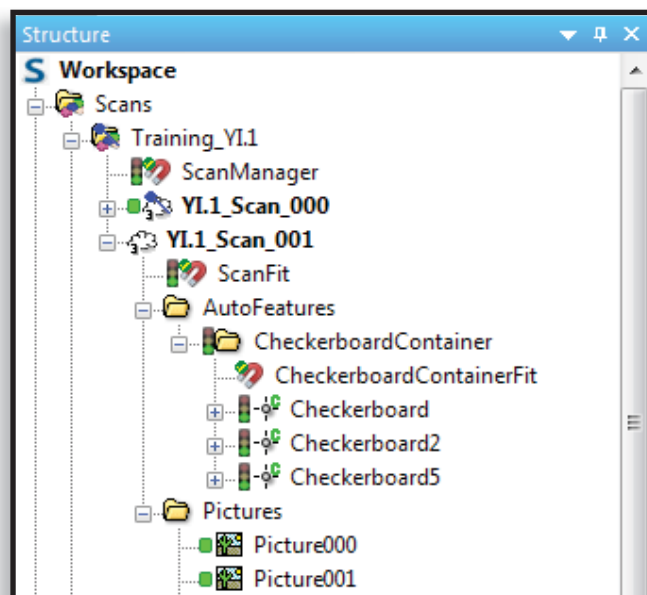**Revert to Revision [x] Dialog Box**

5.   Type *revert*.

6.   Click **OK**.

Icons in the Structure Window

If you expand each element in the **Structure** window after **Preprocessing**, several new icons indicate the status of the project.

Icons in the Structure Window

The specific icons that you see for your scan project will vary, depending on what operations you have performed.

Activity 5.1:
Setting SCENE Options

In this activity, you will

Set Common SCENE Options.

1. Click **Tools** > **Options**.

2. On the **Navigation** tab, select **Invert Mouse Wheel**.

3. If you have used spheres, on the **Matching** tab, click the **Match Sphere** button, then set **Match Sphere Settings**.

4. On the **Folder** tab, under **Project Locations**, use the browse button to enter the default project locations.

5. On the **General** tab, under **Save Options**, enable SCENE to automatically save every 10 minutes.

6. On the **Units** tab, under **Display**, set the units of measure to m (**Length**) and mm (**Small Sizes**).

Import and Open a Scan Project

1. Insert the SD card into the computer.

    A message appears asking if you want to start an automatic data transfer.

2. Click **Yes**.

    SCENE imports the scan project. This may take several minutes.

3. In the **Project Overview** window, navigate to **First_Project_[*Your Initials*]**.

4. Double-click on the project preview.

Automatic Registration – Target Based

1. In the **Structure** window, right-click on the cluster **First_ Project_[*Your Initials*].2**.

2. Click **Operations** > **Preprocessing** > **Preprocess Scan**.

3. Select **Detect Artificial References**,

4. If you have not used spheres, clear the **Spheres** check box. If you have not used checkerboards, clear **Checkerboards** check box.

5. Select **Place Scans**.

6. Select **Create Scan Point Cloud(s)**

7. Click **Configure**.

8. On the drop-down menu, click **Target Based**.

9. Click **OK**.

10. Click **OK**.

11. Save the project.

    A. Click **File** > **Save** or click the **Save** tool.

    B. Under **Comment**, enter **Preprocessed Training_ [*Your Initials*].2**.

    C. Make sure the author name is correct.

    D. Click **OK**.

Lesson 2:
Inspecting the Registration
Results

Every registration has a certain amount of error. Inspecting the
registration ensures that the scans have been registered properly and that
the amount of error is within your tolerance. Your tolerance for error
depends on project requirements.

There are two ways to inspect the registration:

- Using the **ScanManager**.

- Using **3D View**.

Using the ScanManager

The **ScanManager** displays the status of the registration and classifies
the results as good (green traffic light), medium (yellow traffic light), or
poor (red traffic light).

During **Preprocessing**, SCENE automatically creates a **ScanManager**.
You can also manually create a **ScanManager**.

To manually create a **ScanManager**:

1. In the **Structure** window, right-click on a cluster.

2. Click **New** > **Scan Manager**.

There are either three or four tabs in the **ScanManager**, depending on
whether you choose **Target Based** or targetless registration.

For **Target Based** registration, there are up to four tabs, which are:

- **ScanManager**

- **Scan Results**

- **Target Tensions**

- **Scan Point Tension**

ScanManager

For **Top View Based** and **Cloud to Cloud** registration, there are three tabs, which are:

- **ScanManager**

- **Scan Results**

- **Scan Point Tensions**

ScanManager Tab

The **ScanManager** tab displays the quality of each cluster's fit with the reference cluster.

Name – Displays the name of the **ScanManager**. The default name is **ScanManager**. If you change the name and click **Apply**, SCENE updates the registration.

Managed by – Displays the name of the cluster one level higher in the project structure, which is displayed in the **Structure** window.

Used Settings: Opens the **Used Place Scans Settings** dialog box, which displays the settings used for registration.

Sub Manager – Displays the **ScanManager** for each cluster lower in the project structure.

The traffic light symbols indicate the status of the **ScanManager**. A red X indicates that the registration could not be performed, usually due to an insufficient number of common reference objects.

You can open the **ScanManager** for subordinate clusters by double-clicking on the cluster in the **Sub Manager** list.

ScanManager Tab
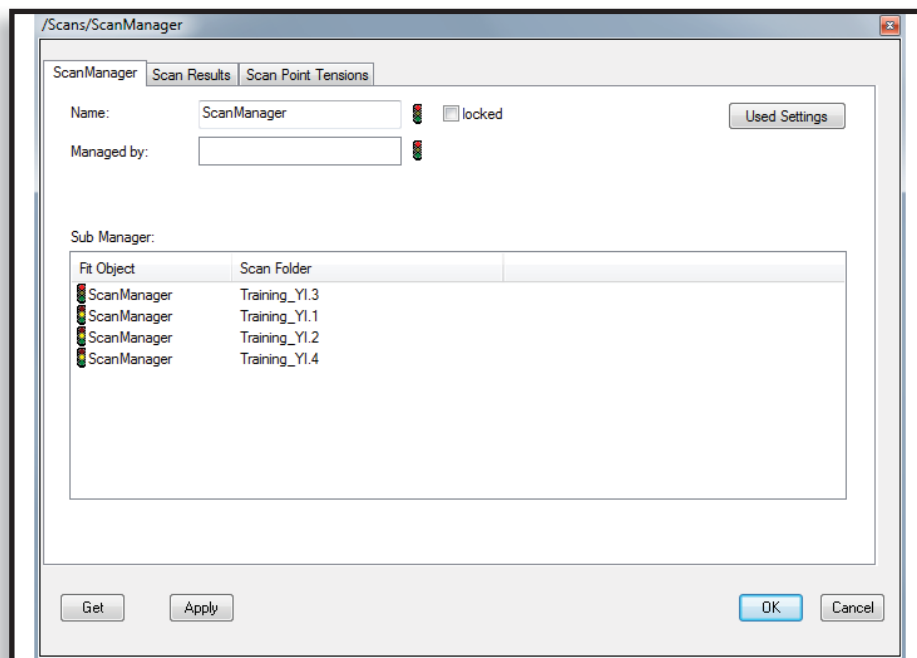
Scan Results Tab

The **Scan Results** tab shows the **Mean Scan Point Tension** for each **ScanFit.** This value is based on how well each scan registered with the reference scan. The lower the value, the more accurate the registration is.

Scan Results Tab
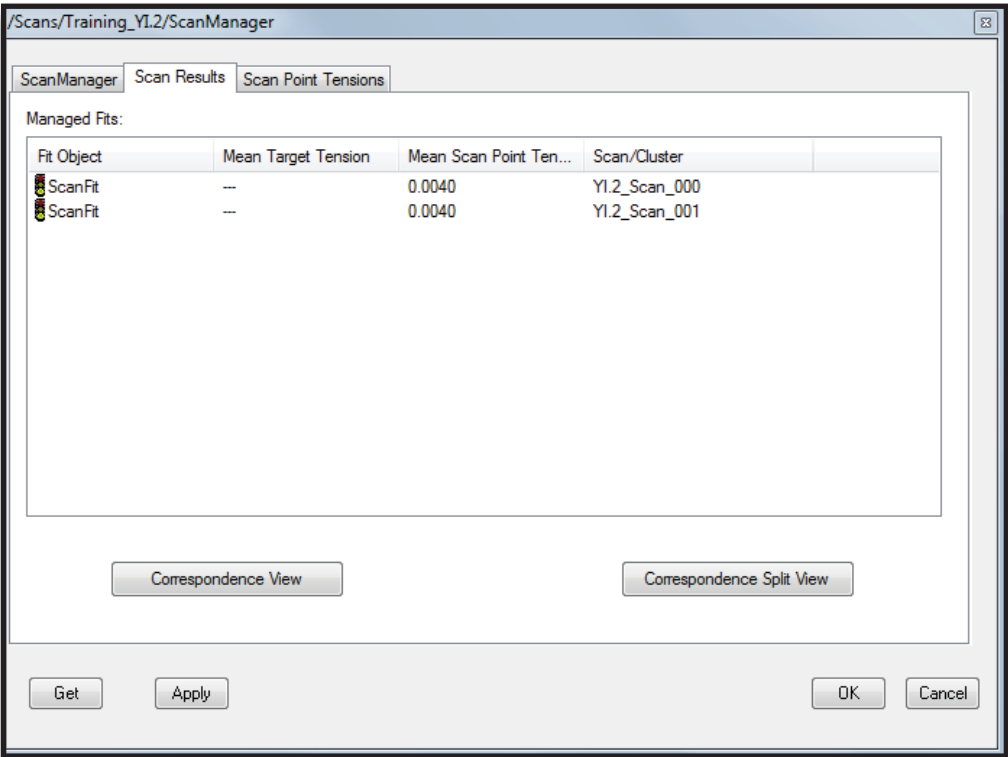
Target Tensions Tab

The **Target Tensions** tab lists the tensions of the correspondences between common reference objects. The tension values are automatically sorted from highest to lowest. The acceptable amount of error depends on your project requirements.

Target Tensions Tab
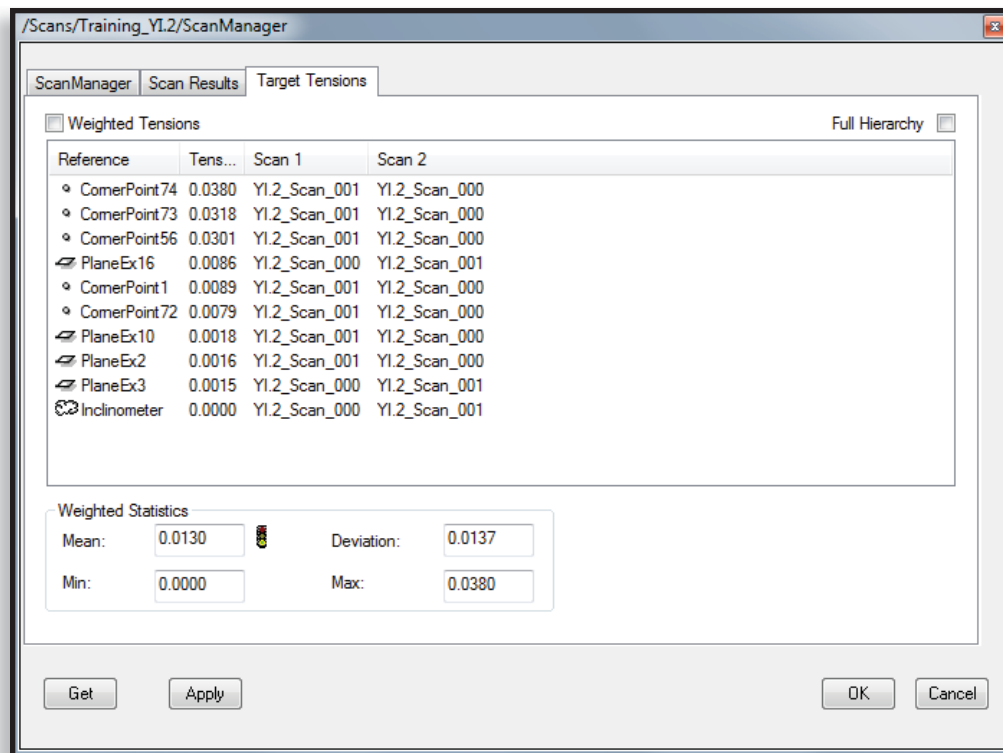
Scan Point Tensions Tab

The **Scan Point Tensions** tab shows each pair of scans in the first two columns.

The remaining columns show:

- **Mean** – Tension between corresponding scan points in each pair of scans.

- **< 0.004 m [%]** – Percent of points with a tension less than 0.004 m (4 mm).

- **Overlap [%]** – Percent of scan points that overlap.

- **Used Points** – Number of scan points used to calculate the values in the **Scan Point Tensions** tab.

- **Details** – Opens a window that displays a **Distance Histogram**.

Scan Point Tensions Tab
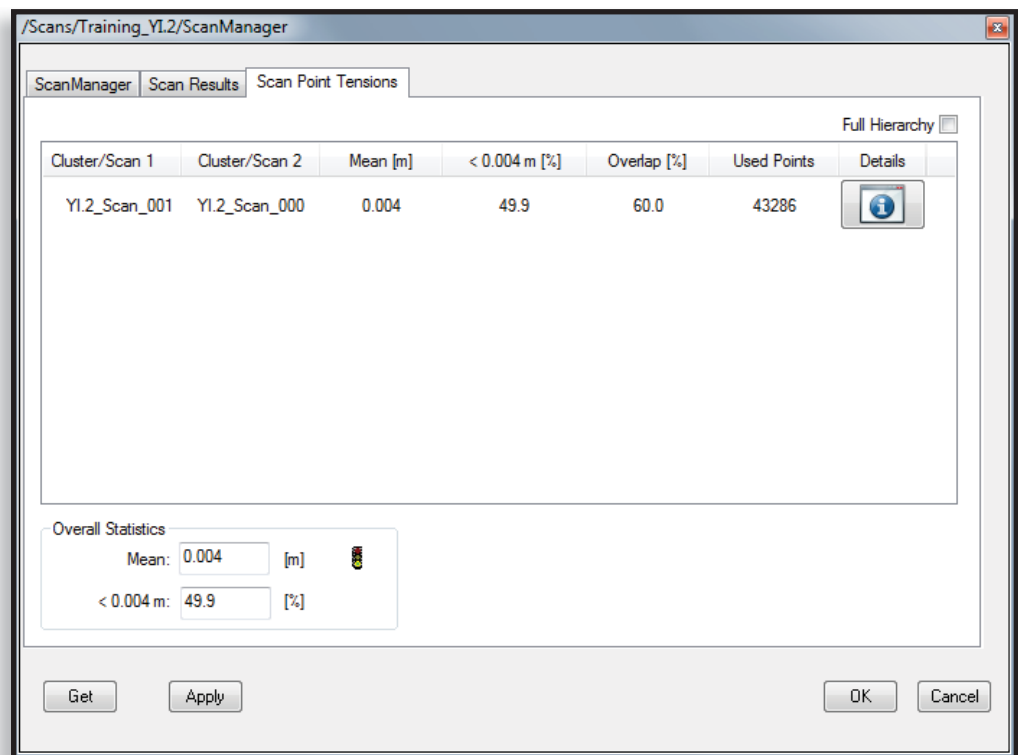
Scan Point Tension Details

The **Scan Point Tension Details** window includes the same information shown on the **Scan Point Tensions** tab, and also includes a **Distance Histogram**, which is a graphic representation of scan point tensions.

Scan Point Tension Details
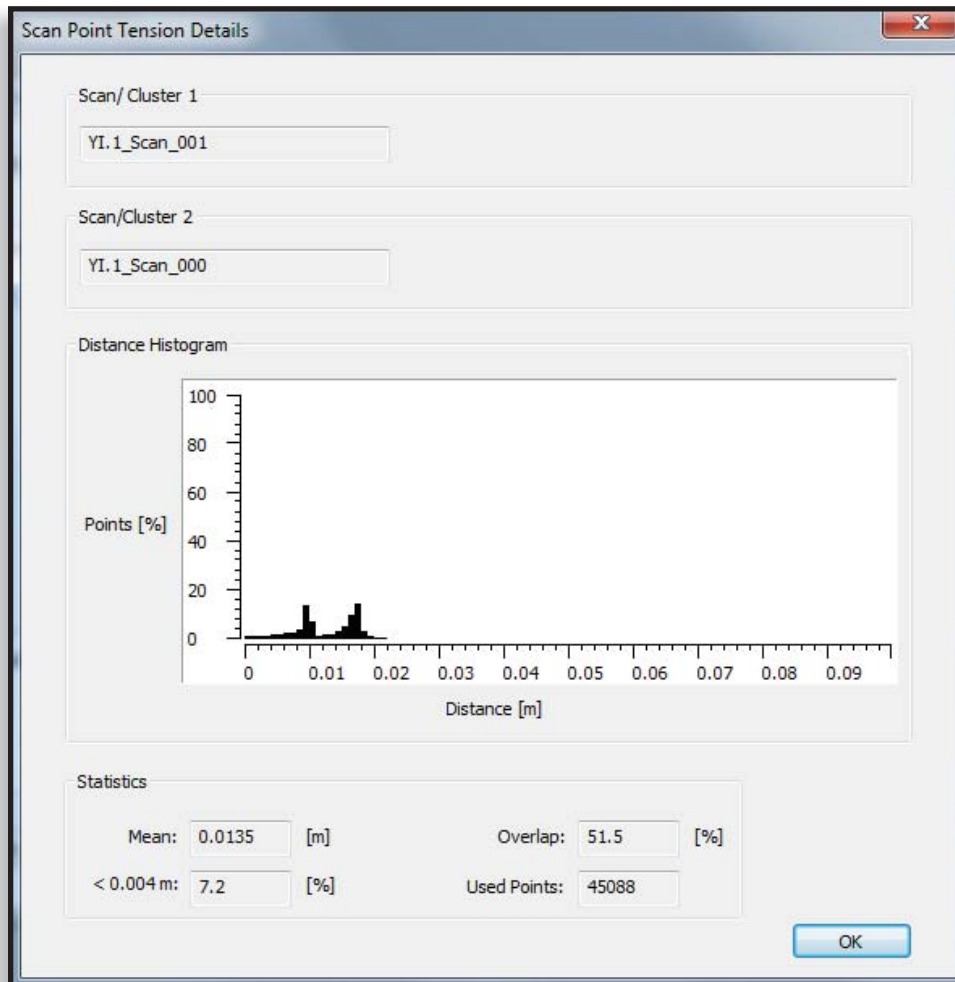
Using 3D View

3D View provides a three-dimensional view of a single scan or multiple individual scans from the point of view of the scanner. It provides a three-dimensional view of a cluster from any user-determined point of view.

Primary Purpose

Use **3D View** to view an individual scan, multiple individual scans, or a cluster.

In **3D View**, you can also:

- Inspect registration results.

- Inspect created objects.

- Creating clipping boxes.

- Crop scan data.

While you can create geometric objects in **3D View**, they cannot be used for registration.

How to Open

There are three ways to open **3D View**.

In the **Structure** window, select a scan, multiple scans, or a cluster, and do one of the following:

- Right-click, then click **View** > **3D View**.

- In the **Standard Toolbar**, click **Create 3D View**.

- In the menu bar, click **View** > **View** > **3D View**.

Scan State

To view scan data in **3D View**, you must either have the scans loaded, have scan point clouds created, or both.

To use the **Polygon Selector**, scans must be loaded and not have scan point clouds created. If scan point clouds are created, the **Polygon Selector** is active and appears functional, but is not.

To use the **Point Cloud Polygon Selector** and the **3D Brush Selector**, scans must have scan point clouds created. They can be either loaded or unloaded – unloaded is recommended.

To work with clipping boxes, scans must be unloaded and scan point clouds must be created.

When you open a scan in **3D View**, the **3D Toolbar** appears. To make the buttons active, click in the image area.

3D Toolbar
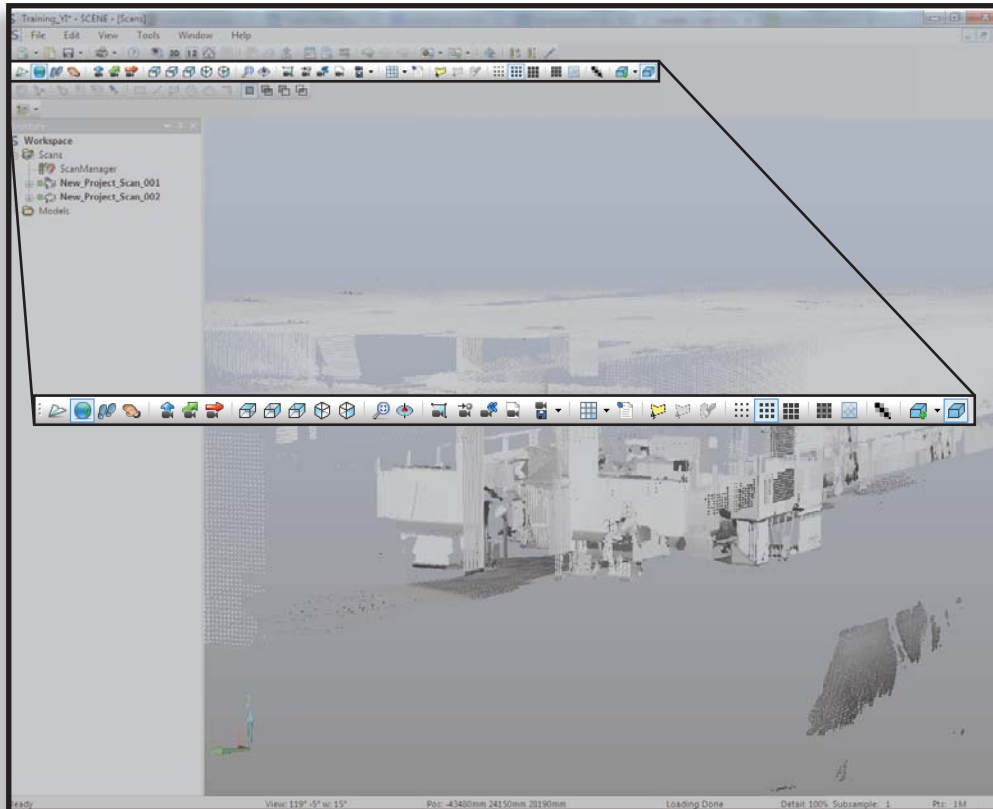
Scan Point Sizing

New in SCENE v5.4 is the ability to manipulate how scan points appear. This is controlled globally in the **3D Visibility Settings** dialog box. Click the **Visibility Settings** icon on the toolbar.

Under the **Scan Point** tab are two options:

- **Fixed** - Each point displays in a fixed size determined by the user, measured in pixels between 1 and 10 pixels per point. Once set, the point size remains the same size, no matter how far the scan point is from the observer.

- **Adaptive** - Points are given a physical size set in milimeters not pixels. Points can be set to a size between 0 and 20mm. Once set, the point size will scale to the distance of the scan point from the observer.
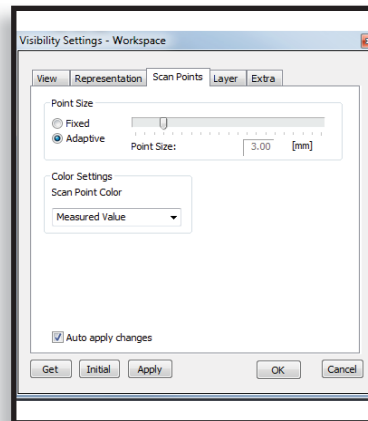
Point sizes can also be adjusted by selecting **Tools > Point Settings...**
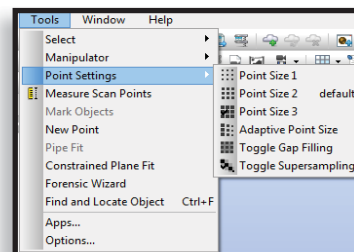
...or using the **Point Size** icons on the **3D View Toolbar**.

Navigation

The **3D Toolbar** includes several navigation tools.

3D View Navigation Tools
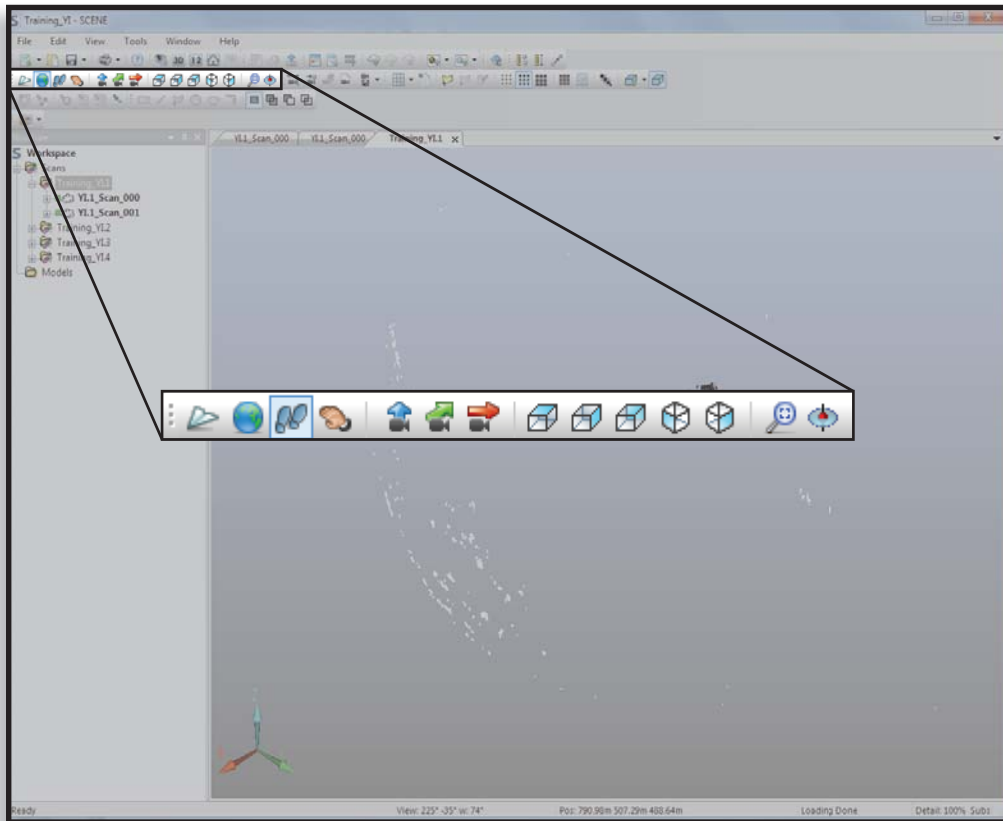
The **3D View** navigation buttons are:

- **Fly** – Click, then drag the mouse to move the image area in the opposite direction from the mouse.

- **Examine** – Click, then drag to rotate the image around the rotation point.

- **Walk** – Click, then drag the mouse to move the image area in the opposite direction from the mouse.

- **Camera Pan** – Click, then drag the mouse to move the image area in the same direction as the mouse.

- **Look up (shift to look down)** – Click to change the orientation of the cluster so you are viewing the scans from above along the z axis. Holding **Shift** while clicking **Look up (shift to look down)** changes the orientation of the cluster so you are viewing the scans from below along the z axis.

- **Look forwards (shift to look backwards)** – Click to change the orientation of the cluster so you are viewing the scans along the y axis,

- **Look right (shift to look left)** – Click to change the orientation so you are viewing the scans along the x axis.

Troubleshooting

If there is no data visible in the image area after using the **Look** tools, click **Change camera position to make all objects visible**.

- **Top view** – Click for a top view. Hold down **Shift** and click for a bottom view.

- **Right view** – Click for a right view. Hold down **Shift** and click for a left view.

- **Back view** – Click for a back view. Hold down **Shift** and click for a front view.

- **Isometric View Left** – Click for a left view angled at 30 degrees.

- **Isometric View Right** – Click for a right view angled at 30 degrees.

- **Change camera position to make all objects visible** – Click to show all objects in the image area.

- **Set Rotation Point** – Click, then click in the image area to set the rotation point, then drag the mouse to rotate the image around the rotation point.

Pressing the **Ctrl** key in **3D View** activates the **Examine** tool.

See the SCENE User Manual[1] for a list of keyboard shortcuts. To open the User Manual, click **Help** > **Contents**.

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[1]Version 5.2.5.36203; February, 2014; Chapter 13.11 (p. 199)

Selection

The **3D Toolbar** includes three selection tools.

3D View Selection Tools
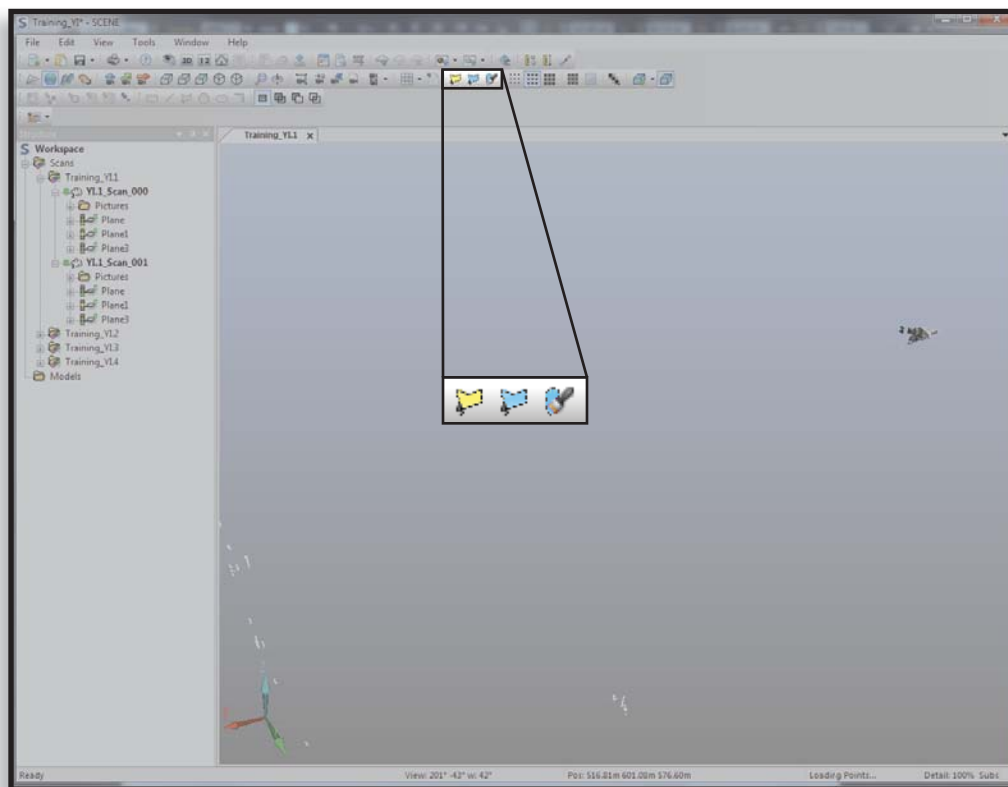
The selection buttons in the **3D Toolbar** are the:

- **Polygon Selector**

- **Point Cloud Polygon Selector**

- **3D Brush Selector**

To clear all selections, hold **Ctrl** and press **D**.

To cancel a selection, press **Esc**.

Troubleshooting

While the boolean selectors (**New Selection**, **Add Selection**, **Subtract from Selection**, and **Intersect with Selection**) in the **Point Selection Toolbar** are active, they do not function.

To use the **Polygon Selector**, scans must be loaded and not have scan point clouds created. If scan point clouds are created, the **Polygon Selector** is active and appears functional but is not.

To use the **Point Cloud Polygon Selector** and the **3d Brush Selector**, scans must have scan point clouds created. They can be either loaded or unloaded.

Activity 5.2:
Inspecting the Registration

In this activity, you will inspect the registration using the **ScanManager** and **3D View**.

Follow these steps:

1. Inspect the registration in the **ScanManager**.

    A. In the **Structure** window, double-click the **ScanManager** under **First_Project_[*Your Initials*].2**.

    B. Click the **Scan Results** tab to view the **Mean Scan Point Tension** for each **ScanFit.**

    C. Click the **Target Tension** tab to view the **Mean Scan Point Tension** for each **ScanFit**.

2. Inspect the registration visually in **3D View**.

    A. In the **Structure** window, right-click on **Training_ [*Your Initials*].2**.

    B. Click **View > 3D View**.

    C. In the Structure window, right-click on **Training_ [*Your Initials*].2**.

    D. Click **Load All Scans**.

    E. Use the navigation tools, the mouse, and the mouse wheel to visually inspect the registration.

Clipping Boxes

Clipping boxes allow you to view only a selected portion of the scan data, and can be useful when inspecting the registration. Clipping boxes can be created in **3D View**.

Clipping Box Buttons in the 3D Toolbar
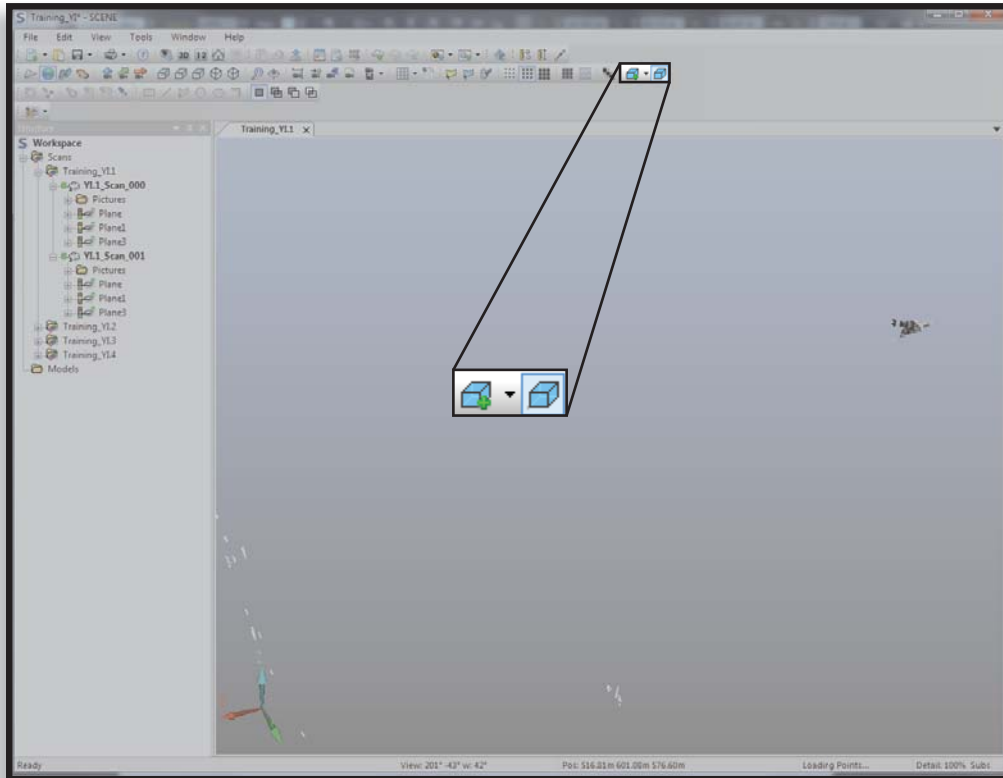
The clipping box buttons in the **3D Toolbar** are:

- **Create a new Clipping Box** – This is a split button that allows you to either create a clipping box in the center of the image area, or create a clipping box attached to a surface.
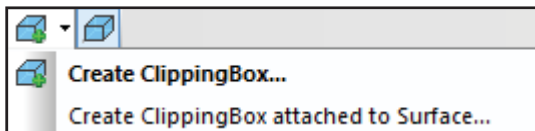
- **Toggle application of Clipping Boxes.** – Switches on and off the visibility of scan points hidden by all of the clipping boxes.

The **3D Toolbar** also contains **Toggle application of Clipping Boxes**, which switches on and off the clipping feature of all clipping boxes; the clipping boxes remain visible, and all scan data is visible.

Scan State

To view scans in **3D View**, the scans must be loaded or scan point clouds must be created. However, to work with clipping boxes, scans must be unloaded.

Troubleshooting

You can create clipping boxes with scans loaded; however, **Hide Exterior** and **Hide Interior** will not work.

When you click **Create a new Clipping Box**, you may receive an error message that tells you to create scan point clouds, even if scan point clouds have been created; if you receive this message, unload the scans.

Clipping Box Elements

There are four elements of clipping boxes that allow you to resize and reposition them.

The elements of clipping boxes are:

- Resize arrows

- Scale manipulators

- Rotation manipulators

- Translation manipulators

Resize Arrows

Resize arrows allow you to resize the clipping box by dragging each side. The color of the arrows correspondences to the color of each axis. The resize arrows appear when you select the clipping box in the **Structure** window or in the image area.

Resize Arrows
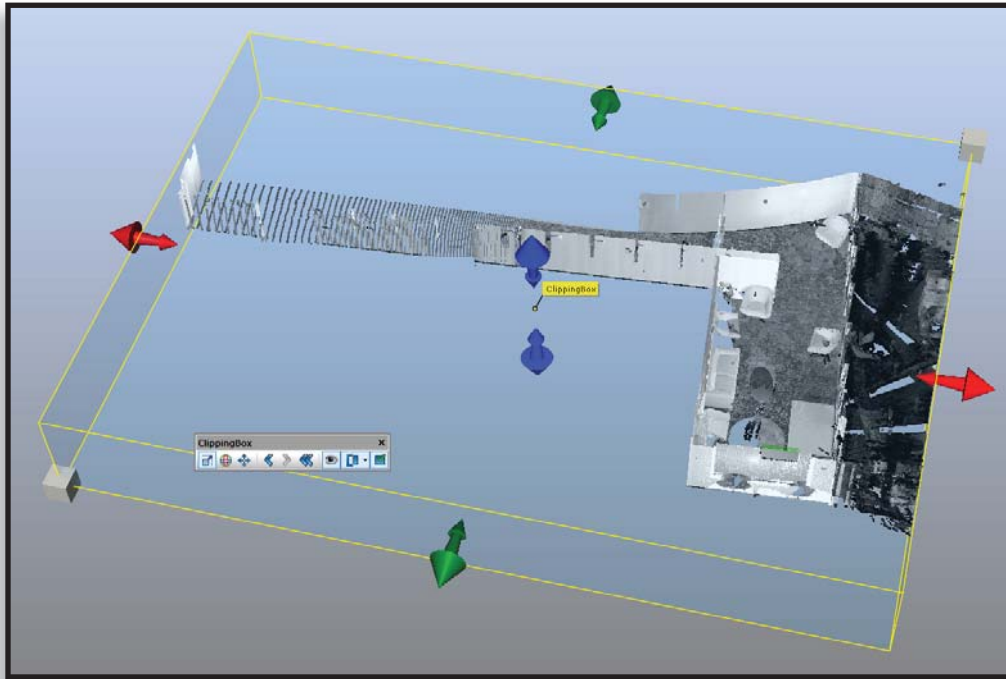
Scale Manipulators

Scale manipulators allow you to scale the clipping box.

Scale Manipulators
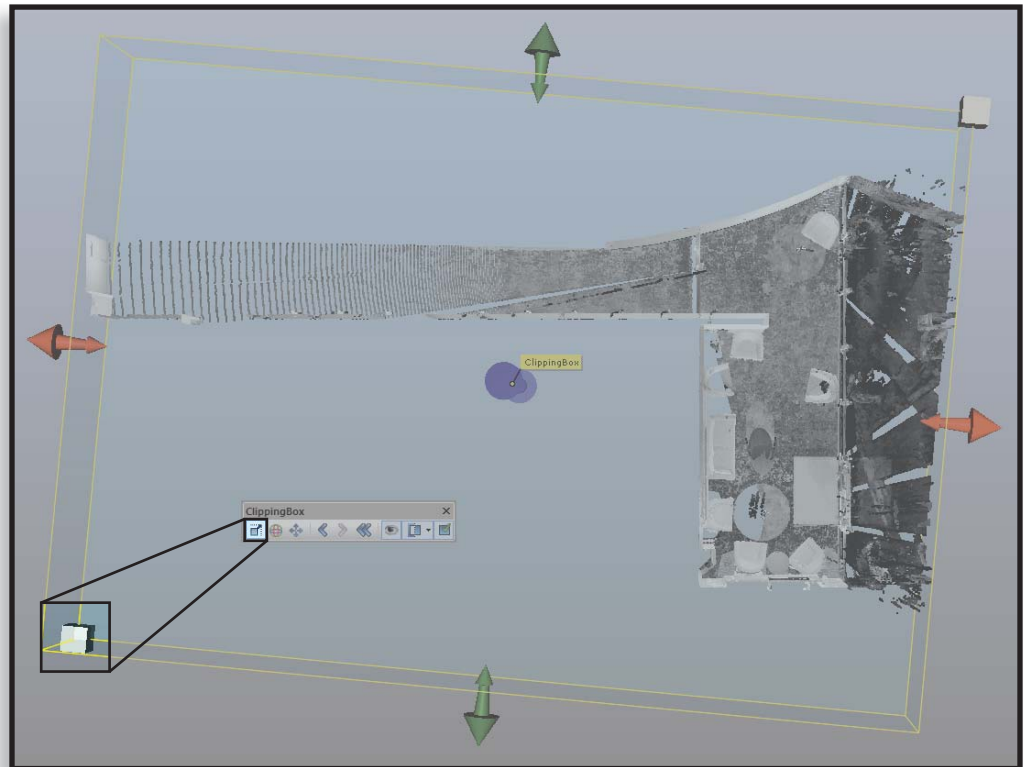
Rotation Manipulators

Rotation manipulators allow you to rotate the clipping box along one of the three axis.

Rotation Manipulators
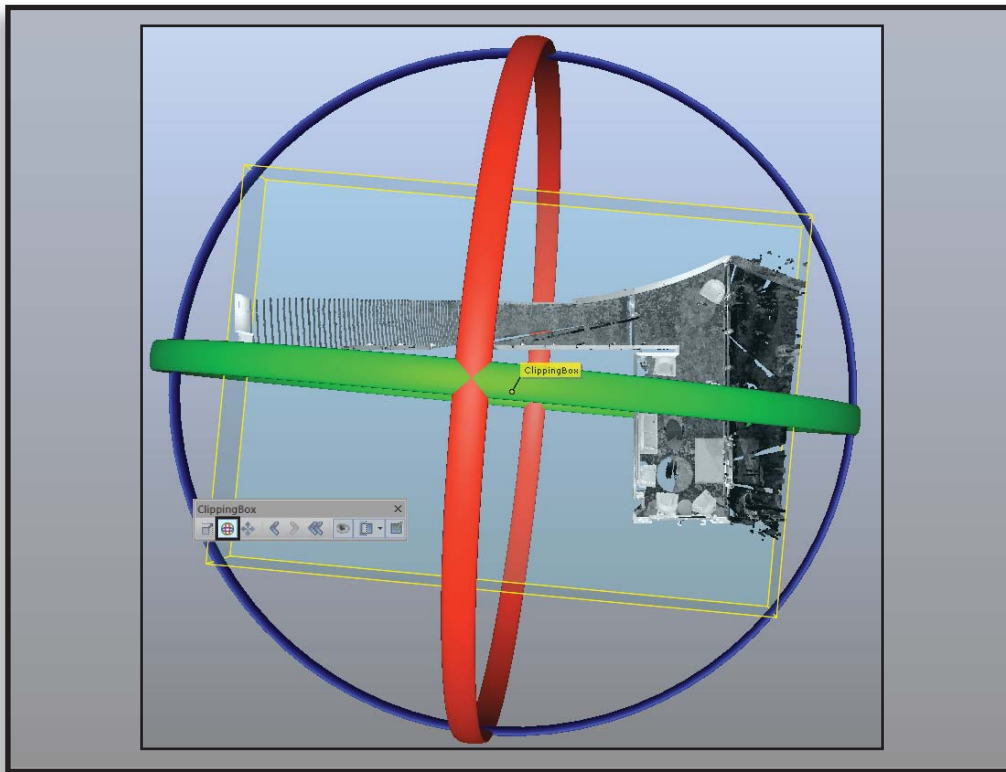
Translation Manipulators

Translation manipulators allow you to move the entire clipping box without altering it.

Translation Manipulators
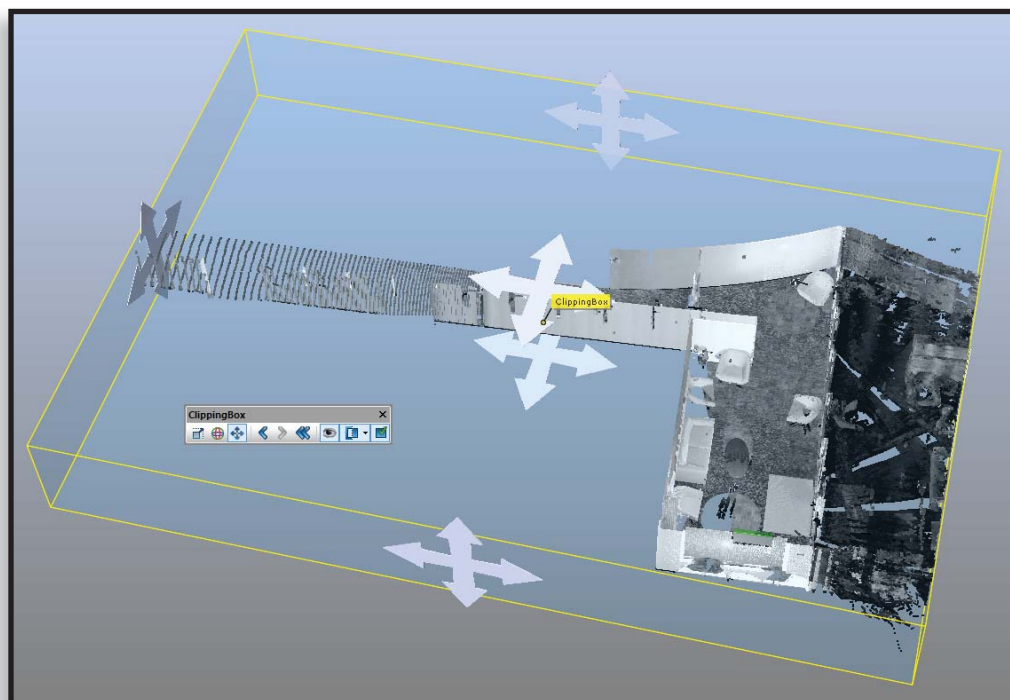
Clipping Box Toolbar

To work with clipping boxes, in the **3D Toolbar**, click **Create a new Clipping Box**. This opens the **Clipping Box Toolbar** and creates a clipping box in the center of the image area.

Clipping Box Toolbar
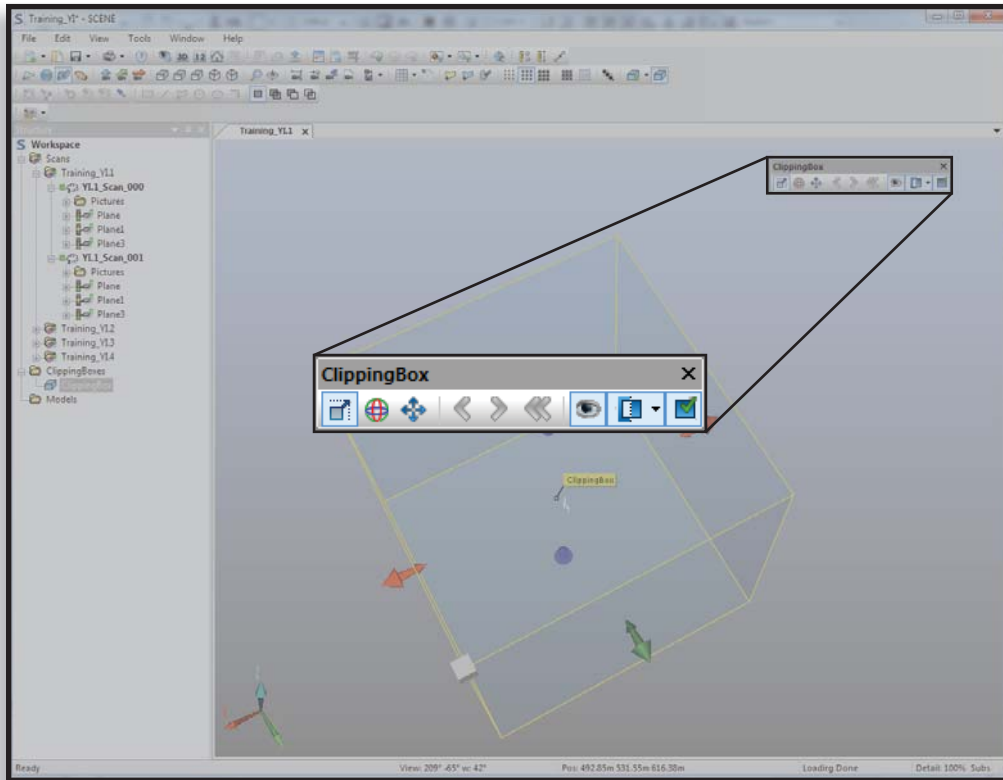
The **Clipping Box Toolbar** contains the following tools:

- **Scale manipulators** – Drag one of the red, green, or blue arrows on the sides of the clipping box, or one of the gray boxes at the corners of the clipping box, to scale it.

- **Rotation manipulators** – Drag the red, green, or blue circle to rotate the clipping box around its center.

- **Translation manipulators** – Drag one of the white crossed arrows on the sides of the clipping box to move it.

FARO

- **Restore previous transformation** – Click to undo the last adjustment made to the clipping box. This feature works on the last two adjustments before becoming inactive.

- **Re-apply transformation change** – Click to redo the last undone adjustment made to the clipping box. This feature works on the last two adjustments before becoming inactive.

- **Restore initial transformation** – Click to restore the clipping box to its initial state.

- **Clipping Box visibility** – Click to switch the visibility of the selected clipping box on and off.

- **Hide points outside the clipping box** – This is a split button with two commands (**Hide Exterior** and **Hide Interior**).

- **Enable/Disable clipping.** – Switches on and off the visibility of scan points hidden by the clipping box. (This button performs the same operation as the **Toggle application of Clipping Boxes** button in the **3D Toolbar**, except for individual clipping boxes, rather than all clipping boxes.)

A clipping box appears in the image area and SCENE automatically creates a folder in the **Structure** window called **ClippingBoxes**, which contains the clipping box.

As subsequent clipping boxes are created, SCENE places them in the **ClippingBox** folder and automatically names them with consecutive numbers. The **Clipping Box Toolbar** also appears in the image area.

> **Troubleshooting**
>
> If the **Clipping Box Toolbar** is not visible, in the **Structure** window, select the existing clipping box in the **ClippingBoxes** folder – this causes the **Clipping Box Toolbar** to appear.

Creating an Aligned Clipping Box

You can create a clipping box so that one side is aligned with a plane (such as a wall) in the scan, using the **Create ClippingBox attached to Surface** command.

To create a clipping box with one side aligned to a plane, in **3D View**, identify the surface (plane) you want to use. Then, in the **3D Toolbar**, click the arrow next to the **Create a new Clipping Box** tool. Click **Create ClippingBox attached to Surface**. In the image area, click on three points of the surface (plane).

Use the buttons in the **Clipping Box Toolbar** to resize and move the clipping box.

Troubleshooting

The **Create a new Clipping Box** button is unavailable until after scans have been registered.

To inspect the clipping box by rotating the scan data, click the **Examine** tool, then click the **Set Rotation Point** tool, then click inside the clipping box.

Troubleshooting

After creating a clipping box, you can only use the **Set Rotation Point** button within the clipping box.

Clear View

When working with clipping boxes, it can be helpful to use **Clear View**, which is a semi-transparent mode in **3D View**. **Clear View** allows you to see through the scan point clouds, which can be useful when working with clipping boxes.

To turn **Clear View** on or off, in the **3D Toolbar**, click **Toggle Clear View**.

You can also press **C** on your keyboard to switch **Clear View** on and off.

Activity 5.3: Working with Clipping Boxes

In this activity, you will practice working with clipping boxes.

Follow these steps:

1. In **3D View**, use the navigation tools, the mouse, and the mouse wheel to navigate to a convenient view.

2. Create a clipping box.

   A. In the **3D Toolbar**, click the **Create a new Clipping Box** tool.

3. Use the navigation tools, the mouse, and the mouse wheel to view the clipping box, and use the buttons in the **Clipping Box Toolbar** to resize and move the clipping box.

4. Hide the clipping box.

   A. In the **Structure** window, in the **ClippingBoxes** folder, click on the **ClippingBox**.

   B. In the **Clipping Box Toolbar**, click the **Clipping Box visibility** tool.

5. Create a new clipping box with one side parallel to a plane in the point cloud.

   A. Use the navigation tools, the mouse, and the mouse wheel to find a plane in the point cloud.

> If buttons in the toolbars are unavailable, try clicking in the image area.

B.   In the **3D Toolbar**, click the arrow next to the
      Create a new Clipping Box tool.
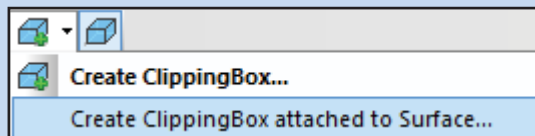
C.   Click **Create ClippingBox attached to Surface**.

D.   Click three points on the plane.

E.   Use the buttons in the **Clipping Box Toolbar** to
      resize and move the clipping box.

6.   Save.

Activity 5.4:
Automatic Registration – Targetless

In this activity, you will automatically register the full scans in **Training_[*Your Initials*].2**. You will start with **Top View Based** registration, and then use **Cloud to Cloud** to refine the registration.

Follow these steps:

1. Automatically register scans using the **Top View Based** configuration.

    A. In the Structure window, right-click the cluster **Training_[*Your Initials*].2**.

    B. Choose one of the following options.

        ◦ Select data from the first Targetless scan

        ◦ "Revert" the scan with Targets, or

        ◦ Take new data

    C. Select **Place Scans**. Clear all other settings.

    D. Click **Configure**.

    E. On the drop-down menu, click **Top View Based**.

    F. Click **OK**.

    G. Click **OK**.

    H. Save the project.

        I. Click **File** > **Save** or click the **Save** tool.

2. Inspect the registration using the **ScanManager** and **3D View**. On the **Scan Results** tab, note the **Mean Scan Point Tensions**.

3. Automatically register scans using the **Cloud to Cloud**

configuration.

A. In the Structure window, right-click on the cluster **Training_[*Your Initials*].2**.

B. Click **Operations** > **Registration** > **Place Scans**.

C. On the drop-down menu, click **Cloud to Cloud**.

D. Click **OK**.

E. Click **OK**.

F. Save the project.

   I. Click **File** > **Save** or click the **Save** tool.

4. Inspect the registration using the **ScanManager** and **3D View**. On the **Scan Results** tab, note the **Mean Scan Point Tensions**.

Lesson 3: Manual Registration Workflow

This lesson introduces you to manual registration and the Manual Registration Workflow steps.

The Manual Registration Workflow steps are:

1. Open each scan in **Correspondence Split View**.
2. Identify common reference objects.
3. Register.

You will also inspect the registration results, as described in the previous lesson.

Manual registration is based on the concept of manually identifying common reference objects in overlapping scans, and, as with automatic registration, requires you to use the **Preprocessing** command and the **Target Based** registration configuration.

Understanding and practicing manually identifying objects allows you to register scans that do not register well during automatic registration.

The components of manual registration can be used in a variety of combinations:

In this lesson, you will also practice working with the **Project History**.

Manual Registration Workflow

1. Open two scans in Correspondence Split View.

Click the Create Correspondence Split View button.

Drag each scan into a Correspondence Split View window.

In the Structure window, expand the file structure of each scan.

2. Identify at least three common reference objects.

Navigate to the same object in both scans.

Use the Mark tools.

Use the Create Objects command.

Use the Find Objects command.

Verify the precision of identified common reference objects as needed.

Click the Force current correspondences between shown scans button.

Save.

3. Register.

Preprocess. → Configure (Target Based). → Save.

Common Reference Objects

Common reference objects are objects that are identified in more than one scan and used to register scans together.

Common reference objects have many different names in SCENE, including **targets**, **geometric objects**, and **references**.

There are two types of common reference objects you can identify in SCENE:

- Targets (also called **Artificial References**)

- Geometric objects (also called **Natural References**)

There are three ways to manually identify common reference objects:

- Using the **Mark** tools. The **Mark** buttons are available in the **Correspondence Split View Toolbar** and in the **Identify Objects Toolbar**.

- Using the selection buttons and the **Create Objects** command. The selection buttons are available in the **Point Selection Toolbar**, and the Create Objects command is available when you right-click on a selection in the image area.

- Right-clicking in the image area and clicking **Find Objects**, then clicking the type of object you want to identify. (This can be done for an entire scan by right-clicking on the scan in the **Structure** window, or for a selection, by making a selection in the image area, right-clicking, and clicking **Find Objects**.)

Be sure to identify at least three common reference objects in each scan, and remember that the more well-distributed the objects are, the more successful the registration will be. (Well-distributed objects are far apart.)

Targets

Targets are artificial common reference objects that have been placed in the scan area.

The types of targets that can be identified in SCENE are:

- Checkerboards
- Circular, Flat Targets
- Spheres
- Sphere Radii

Geometric Objects

In SCENE, geometric objects are common reference objects, other than targets, that can be identified in SCENE.

The types of geometric objects that can be used for registration are:

- Contrast mean point
- Expanded plane
- Line
- Mean point
- Pipe
- Plane
- Point
- Scan point
- Slab

Correspondences

A correspondence is the relationship between the same common reference object in multiple scans. Before identifying targets and geometric objects, it is important to understand how SCENE identifies correspondences.

By default, SCENE automatically detects correspondences as you identify objects. You can turn this feature on or off.

To enable or disable automatic correspondences:

1. In the menu bar, click **Butto**ns > **Options**.

2. Click the **Matching** tab.

3. Click **Place Scan Settings**.

   The **Default Place Scan Settings** dialog box appears.

4. Under **Correspondence Search**, select or clear **Enable online correspondence search**.

You can monitor which common reference objects have been assigned correspondences in the **Structure** window; active correspondences are indicated with a green **C**, and inactive correspondences are indicated with a gray **C**.
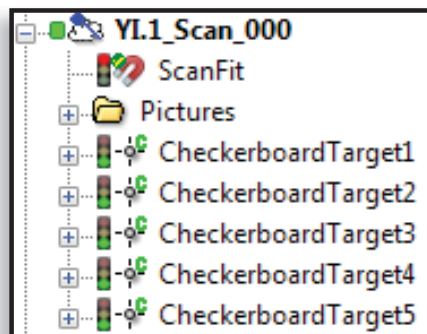
As you identify common reference objects, SCENE processes information about all common reference objects and assigns correspondences. This means that two objects may not have correspondences until more objects have been created.

For scans that have been automatically registered, common reference objects are placed in an **AutoFeatures** folder inside the scan folder. For scans that have been manually registered, common reference objects are placed directly in the scan folder.

Targets Identified During Automatic Registration
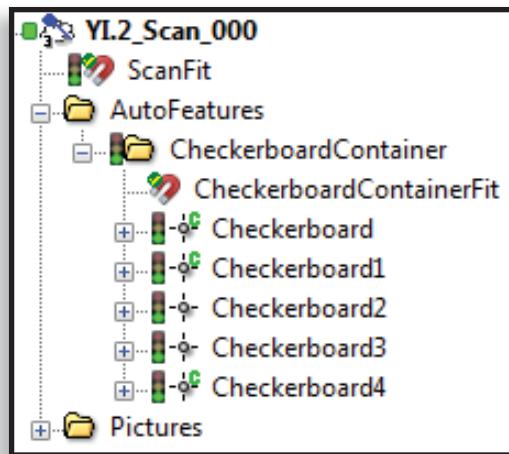
Targets Identified During Manual Registration

Correspondence Split View

Correspondence Split View allows you to manually identify common reference objects for registration. In **Correspondence Split View**, scans are displayed in the image area from the perspective of the scanner position.

Primary Purpose

Use **Correspondence Split View** to manually register scans if automatic registration fails, or as a preliminary step to using the **Cloud to Cloud** configuration during automatic registration.

How to Open

To view scans in **Correspondence Split View**, in the **Standard Toolbar**, click **Create Correspondence Split View**.
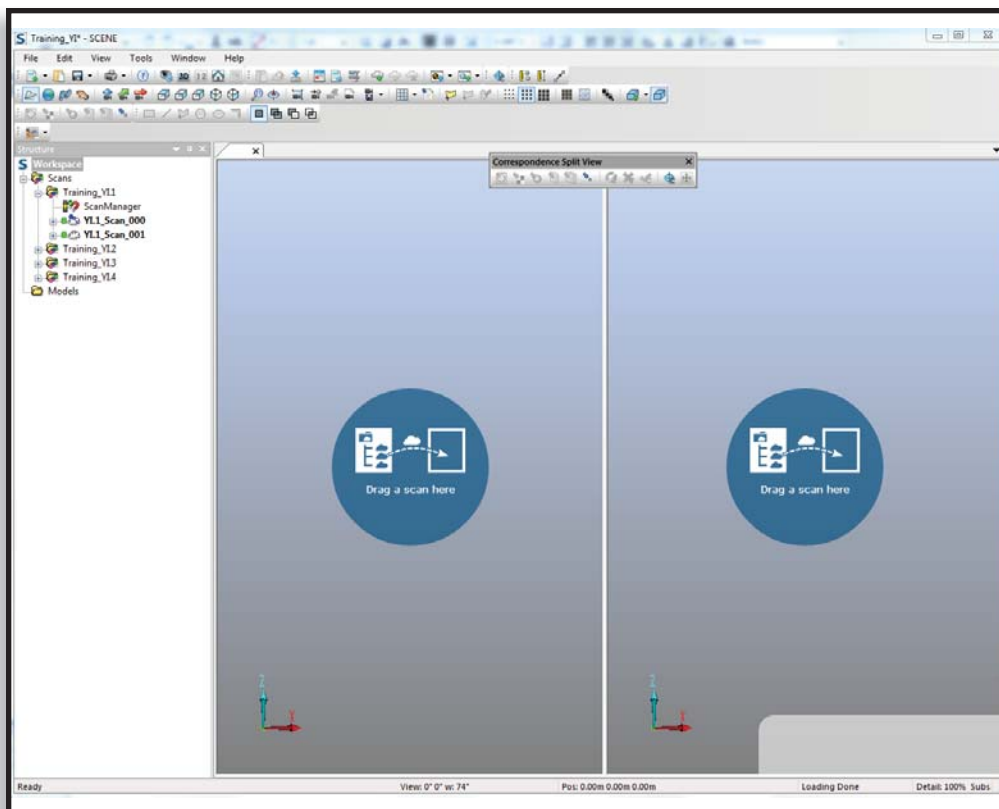

Scan State

SCENE automatically loads scans when you drag them into the **Correspondence Split View** windows.

Navigation

When working in **Correspondence Split View**, two windows are displayed side-by-side in the image area. To view scans in the windows, in the **Structure** window, click on a scan and drag it into the window.
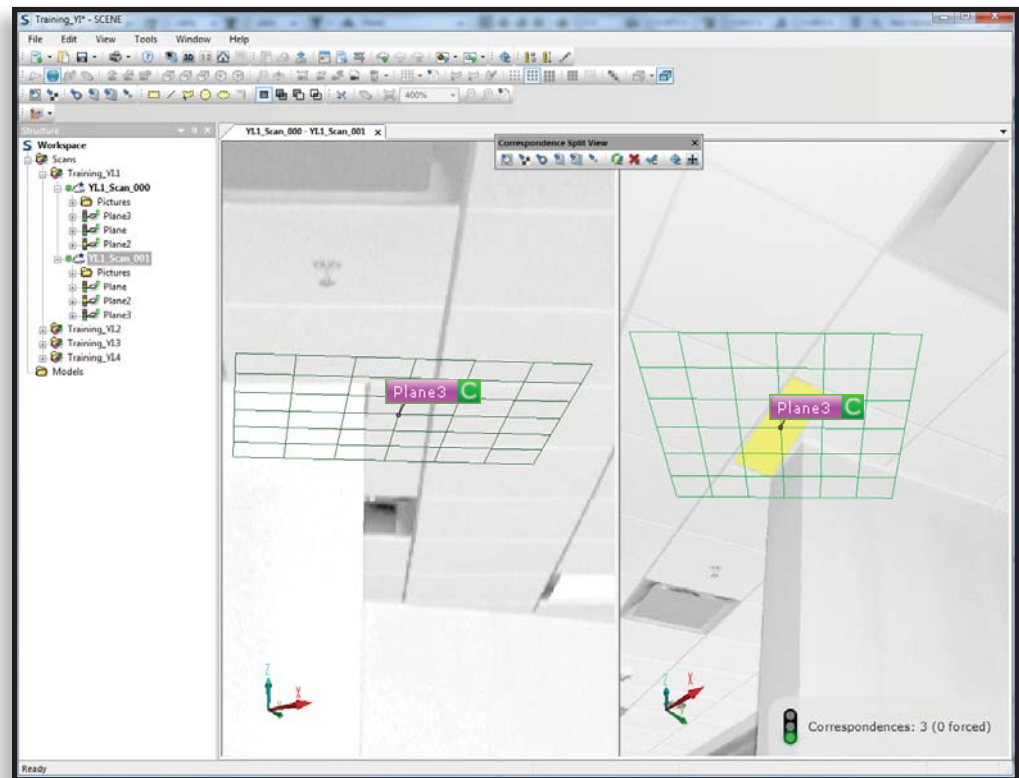
Correspondence Split View

In **Correspondence Split View,** SCENE displays a label for each common reference object. The right side of the label shows the letter C, and the color of the area indicates the type of correspondence; green indicates an automatically detected correspondence, while dark blue indicates a forced correspondence.

The labels contain a maximum of nine characters; if a name has more than nine characters, only the last eight are displayed, and the name is preceded by an asterisk (*).

You have to identify at least three common reference objects before SCENE will detect correspondences and display the correspondence labels.
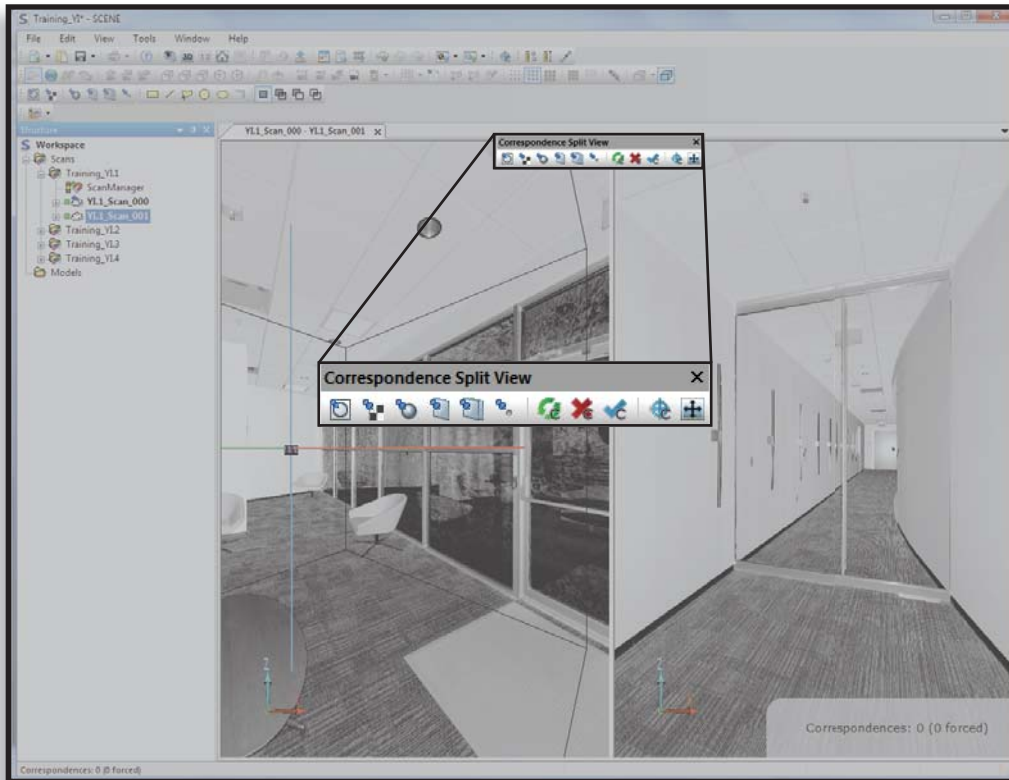
Correspondence Split View Labels

To rotate the scan around the scan position, click and drag in the image area. To zoom in and out, use the mouse wheel.

When you open a scan in **Correspondence Split View**, the **Correspondence Split View Toolbar** appears.

Correspondence Split View Toolbar

The **Correspondence Split View** buttons are:

- **Mark circular flat target**

- **Mark checkerboard target**

- **Mark sphere**

- **Mark plane**

- **Mark slab**

- **Mark a scan point.**

- **Find correspondences between shown scans** – Automatically assigns and labels correspondences

- **Clear correspondences between shown scans** – Clears all correspondences.

- **Force current correspondences between shown scans** – Changes all correspondences to forced correspondences. To make sure that SCENE uses the correspondences shown in Correspondence Split View, you must click this button to force them. (When you register scans, SCENE automatically searches for correspondences, regardless of the correspondences that have been assigned. To ensure that the existing correspondences are used for registration, you must force them.)

- **Force Correspondence** – Forces a correspondence between two common reference objects. After clicking this tool, click the corresponding common reference object in each scan.
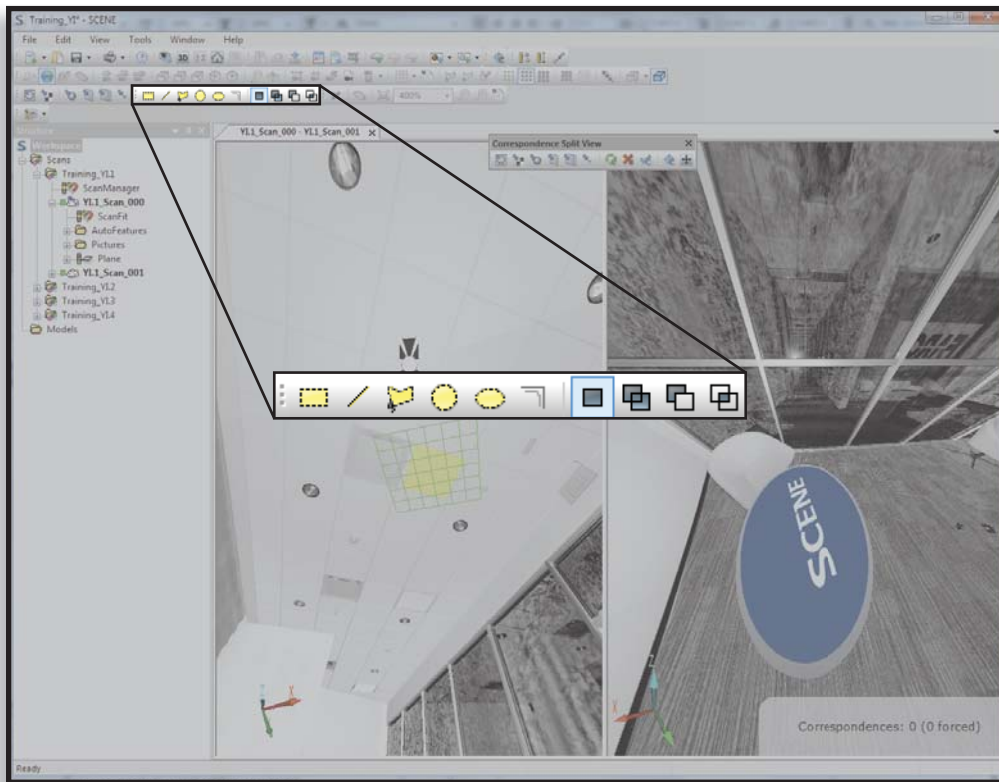

- **Open Correspondence View** – Opens the cluster containing the two scans in **Correspondence View**.

You can also use the selection buttons in the **Point Selection Toolbar**, and the **Create Objects** command to identify common reference objects.

Point Selection Toolbar

The selection buttons in the **Point Selection Toolbar**:

- **Rectangular Selector** – Click, then drag across the image area and release.

- **Line Selector**

  - To select a straight line or a series of connected straight lines, click, then reposition the mouse and click again. Double-click to end the selection.

  - To select a custom line followed by a straight line, click, drag across the image area, release, then reposition the mouse and click again. Double-click to end the selection.

  - To select a custom line, drag across the image area, hold the mouse in place at the end of the selection, and double-click to end the selection.

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- **Polygon Selector** – Click, then reposition the mouse and click again to select each side of the polygon. Double-click to close the polygon and end the selection. This button can also be used to draw a freestyle line by holding the left mouse button..

- **Sphere Selector** – Click, then move the mouse over the image area. Use the scroll wheel on the mouse to resize the sphere. (Pulling the mouse toward you makes the sphere larger.) Position the sphere over the selection area and click to end the selection.

- **Ellipse Selector** – Click, then click in the image area near the area you want to select to start the selection. Drag and use the scroll wheel at the same time to resize the ellipse. Click to end the selection.

- **Polygon Edge Selector** – Click and release, and then move the cursor along an objects edge. Double-click to end the selection.

- Boolean **Selection** tools:

  - **New Selection**

  - **Add Selection**

  - **Subtract from Selection**

  - **Intersect with Selection**

Region

Another important selection feature is a **Region**. A **Region** is a saved selection.

To create a **Region**, right-click in the selected area and click **Create Objects** > **Region**. A dialog box appears. Click **OK**. To highlight a **Region** in the image area, in the **Structure** window, right-click on the **Region** and click **Select**.

To clear all selections, hold **Ctrl** and press **D**.

Be sure to activate the window in which you want to make a selection before clicking a **Selection** button – otherwise, you will have to click the **Selection** button again.

The **Create Objects** command is accessed by making a selection and then right-clicking in the selected area.

To identify an object using the **Create Objects** command:

1. Click one of the **Selection** tools.
2. Select an area in the image area that contains the object you want to identify.
3. Right-click in the selection.
4. Click **Create Objects**.
5. Click the type of object you want to create.

   A dialog box appears.

6. To manually assign correspondences, enter the name of the object in the **Name** field.

## Verifying the Precision of Identified Objects

To ensure that the correspondences are as accurate as possible, it is useful to verify the precision of the identified objects. You can verify the precision of identified objects by viewing a selection from **Correspondence Split View** in **3D View**.

To verify the precision of identified objects:

1. In **Correspondence Split View**, use the **Selection** buttons to select an identified object.

2. Right-click in the selected area.

> When you right-click in a selection, the **Selection of Objects** dialog box may appear. If it does, double-click ****Selection****.

Selection of Objects Dialog Box
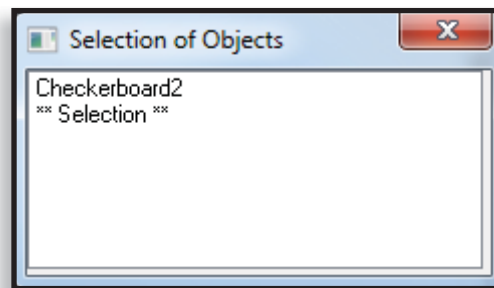
3. Click **View** > **3D View.**

> A new window appears showing the selected area in **3D View**.

4. In the **3D Toolbar**, click **Set Rotation Point**.

5. Click in the image area to set the rotation point.

6. Drag the mouse to rotate the selection and verify the precision of the selection in three dimensions.
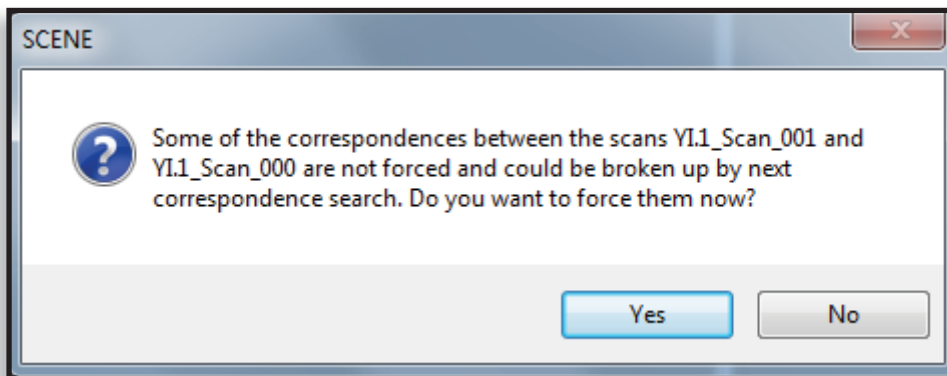
Registering

When registering scans during the Manual Registration Workflow, you must first force the assigned correspondences. During registration, SCENE automatically searches for correspondences, regardless of the correspondences that have been assigned. To ensure that the existing correspondences are used for registration, click the **Force current correspondences between shown scans** button.

If you do not force the correspondences, you may receive a message asking if you would like to force them.

Force Correspondences Message

After forcing the correspondences, register scans using the **Preprocess Scans** command or the **Update Scans** command.

Activity 5.5:
Manual Registration –
Correspondence Split View

In this activity, you will work in **Correspondence Split View** to identify common reference objects in **Training_[*Your Initials*].1**, and manually register the scans.

Follow these steps:

1. Select scans to work with, either by reverting to a previous data set or taking a new set of scans.

2. Open two scans in Correspondence Split View.

    A. In the Standard Toolbar, click the Create Correspondence Split View button.

    B. Drag each scan from the Structure window into a Correspondence Split View window.

3. In the Structure window, expand the file structure of each scan so you can monitor correspondences as they are assigned.

    A. Click the plus sign (+) next to each of the scans.

4. Identify at least three corresponding common reference objects.

    A. Use the mouse and the **Ctrl** key to navigate to the same object in both scans.

    B. Use the **Mark** tools, the **Create Objects** command, or the **Find Objects** command to identify objects.

    C. Verify the precision of identified common reference objects as needed.

5. Click the **Force current correspondences between shown scans** button.

6. Save the project.

   A. Click **File** > **Save** or click the **Save** tool.

7. Register the scans.

   A. In the **Structure** window, right-click on the cluster, then click **Operations** > **Registration** > **Place Scans**.

   B. On the drop-down menu, click **Target Based**.

   C. Click **OK**.

   D. Click **OK**.

8. Save.

9. Inspect the registration.

   A. Inspect the registration using the **ScanManager**

   B. Inspect the registration in **3D View**.

10. Save.

Module Summary

This module explained steps 2 and 3 of the Basic SCENE Workflow, which are registration and inspection.

You should now be able to:

- Identify the Automatic Registration Workflow steps.

- Identify the three automatic registration configurations.

- Register scans using the **Target Based** configuration.

- Automatically identify common reference objects using the **Preprocessing** command.

- Create clipping boxes.

- Save the scan project.

- Inspect the registration using the **ScanManager**.

- Inspect the registration in **3D View**.

- Create clipping boxes.

- Register scans using the **Top View Based** and the **Cloud to Cloud** configurations.

- Work with scan data in **Correspondence Split View**.

- Manually identify targets and geometric objects using the **Mark** tools.

- Manually identify targets and geometric objects using the **Create Objects** command.

- Inspect the accuracy of identified objects.

- Automatically identify correspondences.

- Force correspondences.

Module 6:
Basic SCENE Workflow
(Continued)

This module explains the remaining steps in the Basic SCENE Workflow. The steps for completing the Basic SCENE Workflow are the same, whether you have used automatic or manual registration.

Which steps you follow depends on the scan data and project requirements.

This module contains three lessons:

- Lesson 1: Refining the Registration

- Lesson 2: Pulling Dimensions

- Lesson 3: Preparing for Exporting

- Lesson 4: Exporting

Lesson 1: Refining the Registration

Refining the registration refers to the process of increasing the accuracy of the registration and reducing error. Refining allows you to have more control over the amount of error and more confidence in the results.

Inspecting and refining are conducted in conjunction with one another – repeat each process until you are satisfied with the results.

Refining the registration is based on ignoring the correspondences with the highest tensions.

To refine the registration, open the **ScanManager**, then click on the **Target Tensions** tab.

The **Tension** values (second column) are automatically sorted from highest to lowest.

Target Tensions Tab
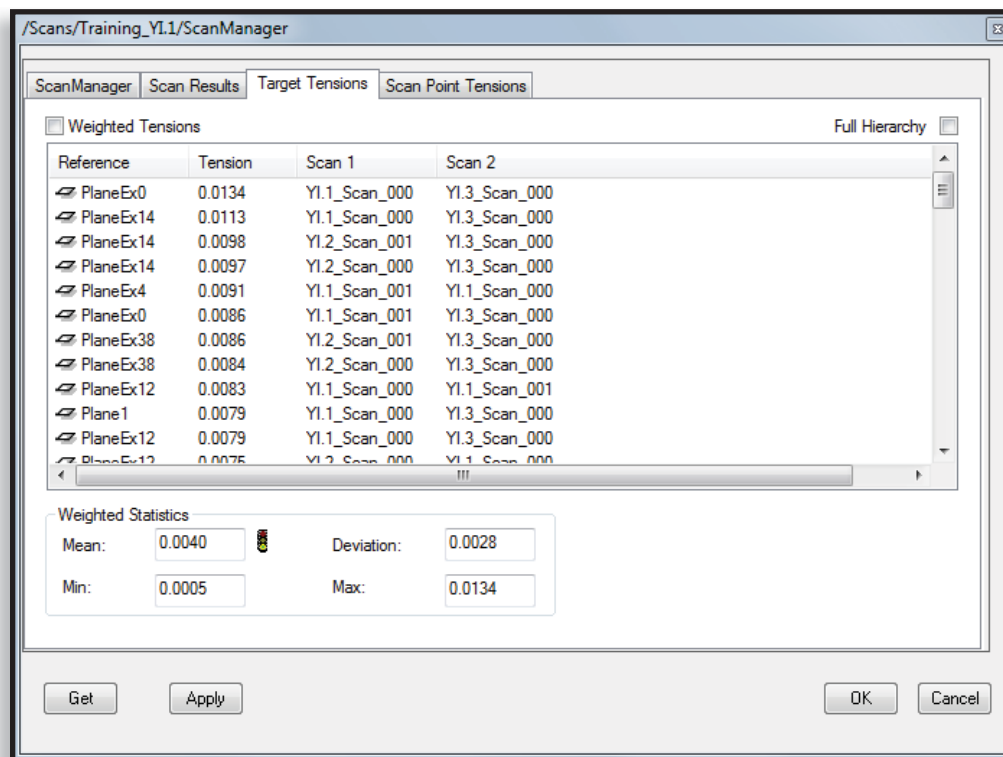
Ignoring Correspondences

To ignore a correspondence, in the **Reference** column, right-click on the common reference object at the top of the list, then click **Locate**.

Locate Command
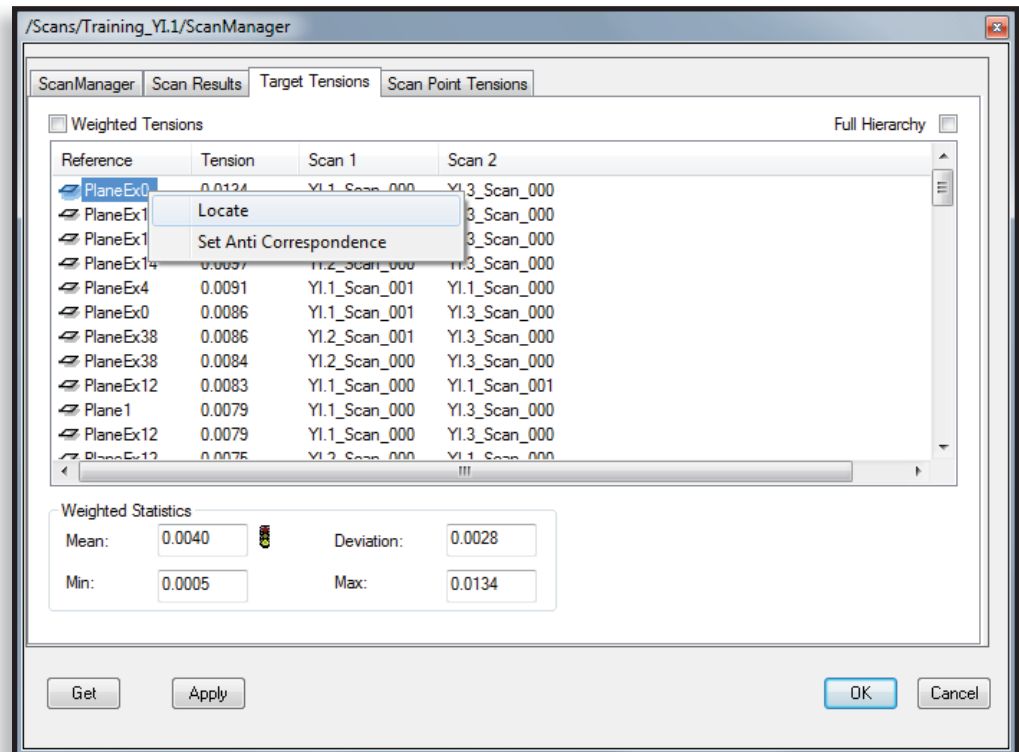
The common reference object is highlighted in the **Structure** window and in the image area. (SCENE also automatically displays the cluster in **3D View**.)

In the **Structure** window, right-click on the common reference object, then click **Properties**. This opens the dialog box showing the properties of the common reference object. Click the **General** tab.

General Tab
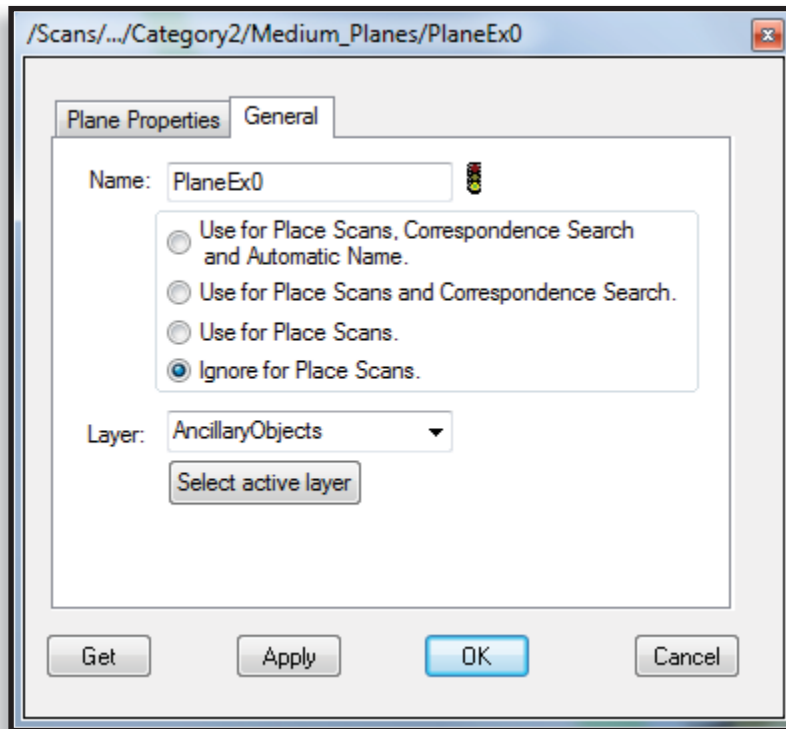
To quickly minimize the list of files and folders in the Structure window, click the plus sign next to the Scans folder. You can then expand specific files and folders by clicking the minus sign next to them.

On the **General** tab, the options for how a common reference object is used during registration are:

- **Use for Place Scans, Correspondence Search and Automatic Name.** – This default setting causes SCENE to automatically assign correspondences, use the common reference object during registration, and automatically change the common reference object's name based on assigned correspondences.

- **Use for Place Scans and Correspondence Search.** – This setting causes SCENE to automatically assign correspondences and use the common reference object during registration, but the common reference object's name will not be changed based on assigned correspondences; instead, the names of the corresponding reference object in other scans will be changed to match the name of this common reference object.

- If you manually rename a common reference object (on the **General** tab), then this setting is automatically selected.

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- **Use for Place Scans.** – This setting causes SCENE to use the common reference object during registration, but correspondences are not automatically assigned, and the name of the common reference object is not changed.

- **Ignore for Place Scans.** – This setting causes SCENE to ignore the common reference object during registration. SCENE does not assign correspondences, and the name is not changed.

To refine the registration, select **Ignore for Place Scans**, then click **OK**.

To update the registration, in the **ScanManager**, click **Apply** or **OK**. SCENE automatically updates the registration and removes the correspondence from the **Tension** column.

The common reference object is still visible in the **Structure** window. To undo this process and use the correspondence for registration, in the **Structure** window, right-click on the common reference object, then click **Properties**. On the **General** tab, select **Use for Place Scans, Correspondence Search and Automatic Name**.

> **Troubleshooting**
>
> You can also use the **Locate** command by right-clicking on an object in the **Structure** window; however the **Locate** command is only available for the scan that is active. To activate a scan, click in the image area or on the bar along the top of the window.
>
> All other commands are active at all times. If there are no view windows open, **Locate** is active, but not functional.

Troubleshooting

Ignoring correspondences can generate an error if too few correspondences remain; at least three are necessary for registration. Creating and updating a **ScanManager** with too few correspondences causes the error message to appear.
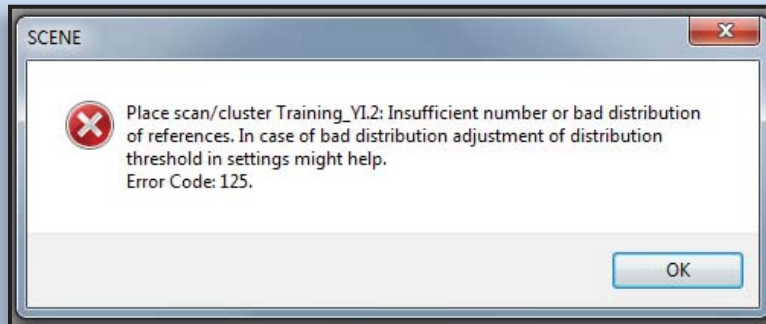
Activity 6.1:
Refining the Registration

In this activity, you will refine registration to reduce the error.

Follow these steps:

1. Select the common reference object with the highest Tension.

    A. In the **Structure** window, double-click the **ScanManager** to open it.

    B. Click the T**arget Tensions** tab.

    C. Right-click the first common reference object in the **Reference** column, then click **Locate**.

        The common reference object is highlighted in the **Structure** window and in **3D View** image area.

2. Ignore the correspondence.

    A. In the **Structure** window, right-click the common reference object, then click **Properties**.

    B. Click the **General** tab, then select **Ignore for Place Scans**.

    C. Click **OK**.

3. Update the registration.

    A. In the **ScanManager**, click **Apply**.

        SCENE updates the registration, and the common reference object disappears from the list of **References**.

        You can also update the registration by right-clicking the **ScanManager** in the **Structure** window and clicking **Update Scans**.

4. Save.

Lesson 2: Pulling Dimensions

Because SCENE renders in scale, determining dimensions of objects in a scene is a simple function. Measurements can be saved as a permanent part of the file and marked on the scene.

There are two methods of measurement:

- With the **Measure between Points** tool, or
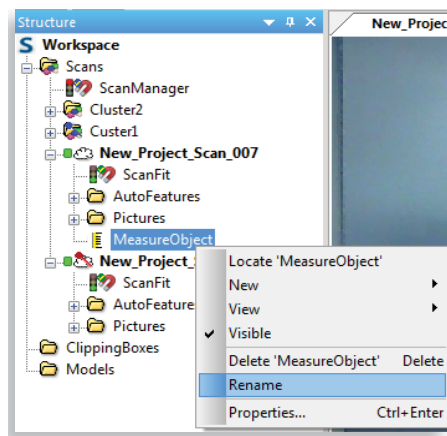
- By placing points and measuring between objects.

Measure Between Points

To measure between scan point, first choose and open the scan with the best view of the scale and the points to be measured. Navigate to the best zoom for a good view of both points to be measured.

Open the scan in **Planar** or **Quick View** by right-clicking the scan, selecting **View** and clicking **Planar** or **Quick View**.

With your area to measure on the screen, click the **Measure between Points** icon.

Place the crosshairs of the cursor on the first point to be measured. Drag the line to the next point of measurement and double-click to close the tool. Measurement values will display on the screen AND with the scan itself as **Measure Object** in the **Structure** window. Right-click the measurement and select **Rename** to rename with a predictive label.

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Measure Between Objects

When measuring between objects, the Z access comes into play. For that reason, place points with the **Mark Point** tool in **Planar** or **Quick View** and check accuracy with the **3D view**.

Open the scan in **Planar** or **Quick View.** Zoom to the area to measure.

Click the **Mark Point** icon on the toolbar. The cursor turns into a pushpin. Click the first measurment point. A properties box opens.
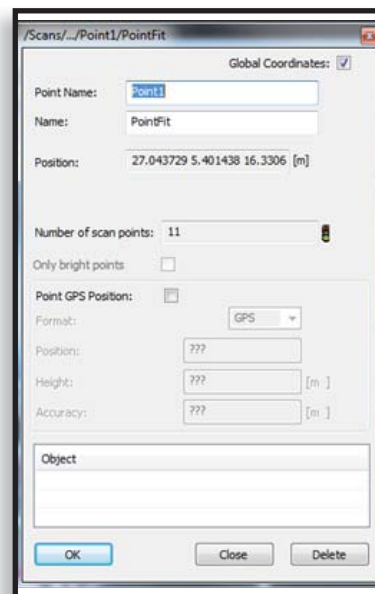
Change the **Point Name** to a predictive name and click **OK**.

Verify the created point is acceptable (on the right plane) by clicking the **Select Rectangle** icon and scrolling an area to view.

Right-click the selection box, click **View > 3D View**.
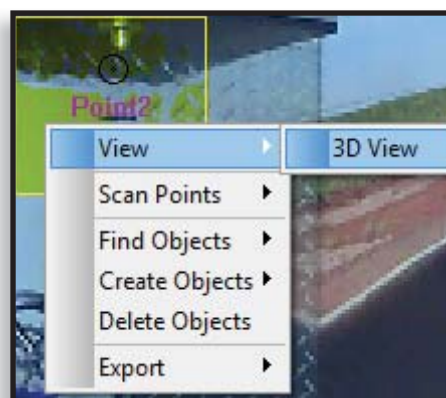
Click the **Set Rotation** icon.

Rotate the view to determine proper placement of the point and then close the 3D window.

On the scan, navigate to the next point to capture, click the **Mark Point** icon and create the second point. For each point placed, check accuracy in the 3D view.

Note: You may want to place all points and review accuracy upon completion. The point naming convention in the properties panel will reset to default if the placing sequence is broken.

Once points are placed, click the **Measure between Objects** icon.

On the **Structure** window, select the two objects (points) to measure. A **Measure Object f**ile will appear under **Measurements**. Right-click and rename. Double-click the measurement file to open a properties box.

Note: On sloping survaces, the Overall distance is the value used. The other distances may be unchecked.

Activity 6.2
Pulling Dimensions

In this activity, you will measure between two points, and then measure between two object. To measure between two points:

1. Select a scan.

2. Change to **Planar** view.

3. Click the **Measure between Point** icon.

4. Click the first point of your choice.

5. Double-click the second point.

6. Rename the **Measure Object**.

To measure between two objects:

1. Select a scan.

2. Change to **Planar** view.

3. Click the **Mark a Scan Point** icon.

4. Click the point of your choice.

5. Using the **Select Rectangle** tool, scroll a rectangle over the point.

6. Right-click the selection box and click **View>3D View**.

7. Click the **Set Rotation** icon.

8. Click in the selection box.

9. Rotate the selection to determine if it is on the right plane.

10. Close **3D View**.

11. Repeat steps 10 with a second point.

12. Rename the **Measure Object**.

Lesson 3: Preparing Scan Data for Exporting

Preparing scan data for exporting involves several processes, such as cropping and applying color information. The processes you select depend on your scan data and project requirements.

There are several reasons to prepare scan data for exporting. You can minimize the size of the exported files, remove unwanted scan points and objects, and customize other settings. There are many different operations you may want to perform before exporting.

The two most common tasks involved in preparing data for export are:

- Cropping out unwanted scan points.

- Applying color information.

A typical series of operations involved in preparing the data for export after applying color information also includes:

- Aligning the point cloud.

- Adjusting the visibility of the scanner positions, as well as the **Matched Objects** and **References** layers.

Cropping

Cropping allows you to remove unwanted scan points and minimize the size of the scan files.

There are two types of cropping:

- General – Cropping data outside the object or area of interest so the exported data includes only the object or area of interest

- Detail – Cropping data inside the object or area of interest to remove unwanted details, such as the residual images of traffic or checkerboards

General Cropping

General cropping is the process of removing scan data outside of the object or area of interest.

3D View is used for general cropping. To crop scan points in **3D View**, load the scans for the cluster you want to crop. Then use the **Polygon Selector** to make a selection. When you make a selection and right-click on the selection, you have the option to delete all scan points either inside or outside of the selection.

Scan State

Scans must be loaded, without scan point clouds created.

> **Troubleshooting**
>
> To use the **Polygon Selector**, which is used for cropping in **3D View,** scans must be loaded without scan point clouds created. If scan point clouds are created, the **Polygon Selector** is active and appears functional, but is not.

Activity 6.3:
Cropping – General

In this activity, you will practice crop unwanted scan data.

1. Delete all scan point clouds.

    A. Right-click the scan and select **Operations > Point Cloud Tools > Delete Scan Point Cloud.**

2. Load the scans in the cluster you want to crop.

    A. In the **Structure** window, right-click on the cluster.

    B. Click **Load All Scans**.

3. View the cluster in **3D View**.

    A. Right-click on the cluster in the **Structure** window.

    B. Click **View** > **3D View**.

4. Use the navigation tools, the mouse, and the mouse wheel to view the scan data.

5. Use the **Polygon Selector** button to make a selection – either the area you want to keep or the area you want to remove.

6. Delete the unwanted scan data.

    A. Right-click in the selected area.

    B. Click **Delete Inside Selection** or **Delete Outside Selection**. To make a new selection, cancel an existing selection by clicking **Remove Selection** or pressing **Ctrl D**. Repeat as needed.

7. Save.

FARO

Detail Cropping

Detail cropping is the process of removing scan data within the object or area of interest. You may, for example have scan data that depicts a person walking through the scan area during scanning, which you want to remove, or you may want to remove spheres or checkerboards so they do not distract from the object or area of interest.

Both **Planar View** and **3D View** are used for detail cropping. This process is similar to the process used for verifying the precision of identified objects.

To crop details out of a scan:

In **Planar View**, make a selection, then right-click on the selection and click **View** > **3D View**.

To rotate the selection, click the **Examine** button.

Then click the **Set Rotation Point** button.

Click in the image area to select the point around which you would like the selection to rotate, then click and drag the mouse to rotate the image.

Use the **Polygon Selector** button to select the points you want to remove.

Right-click in the selection and click **Delete Inside Selection**. Use the navigation buttons to inspect the data and continue cropping as needed.

Because **Planar View** displays only a single scan, you may need to open multiple scans in **Planar View** to remove data related to the same object (a single sphere that has been captured in multiple scans, for example).

Scan State

Scans must be loaded, without scan point clouds created.

Troubleshooting

When scan data is cropped, you may need to zoom in or out (move the mouse wheel in the image area) to refresh the view.

Activity 6.4:
Cropping – Detail

In this activity, you will practice detail cropping of unwanted scan data.

Follow these steps:

8. Open a scan in **Planar View**.

    A. In the **Structure** window, right-click on a scan and click **View** > **Planar View**.

    A. Use the navigation tools, the mouse, and the mouse wheel to find the area you want to work in.

9. View the area to be cropped in **3D View**.

    A. Use the selection buttons to select the area you want to crop.

    B. Right-click on the selection and click **View** > **3D View**.

    C. Click **Set Rotation Point**, click in the image area to set the rotation point, and rotate the selection as needed.

10. Delete the unwanted scan data.

    A. Use the **Polygon Selector** button to select the scan points you want to remove.

    B. Right-click in the selected area and click **Delete Inside Selection**.

    C. Repeat as needed.

11. Save.

Alignment

The orientation of the scan project is derived from the orientation of the reference scan. To change the orientation, you can use the **Alignment** command.

The **Alignment** command allows you to select a plane or a slab and align it with a cardinal direction or designate it as the floor or ceiling. In SCENE, north is in the positive direction on the *y* axis and east is in the positive direction on the *x* axis.

To align a scan:

1. In the **Structure** window, expand the folder structure and select a plane.
2. Right-click, then click **Alignment**.
3. Click the type of alignment you want to use.

Visibility Settings

As you prepare scan data for exporting, you may want to show or hide scan elements, such as scan names and reference objects.

There are several ways to adjust the **Visibility Settings** for these elements.

You can adjust the visibility settings for some elements (such as common reference objects) using the **Structure** window. Right-click on the element and click **Visibility** to switch the visibility on or off.

Scans

To adjust the visibility settings for an individual scan:

1.   Open the scan in one of the views.

2.   In the **Standard Toolbar**, click **Visibility Settings**.

> A **Visibility Settings** dialog box opens. In **Quick View**, the dialog box has three tabs: **View**, **Layer**, and **Extra**. In **Planar View** and **3D View**, the dialog box has two tabs: **Layer** and **Extra**. In **Correspondence View**, the dialog box has four tabs: **View**, **Scan Points**, **Layer**, and **Extra**.

3.   Click the **Layer** tab.

4.   Click in the **Visible** and **Names** columns to switch the visibility of each element on or off.

Views

To adjust the default visibility settings for **Planar View** and **3D View**:

1.   In the **Structure** window, right-click on **Workspace**.

2.   Click **Visibility** > **3D Visibility Settings** or **Planar View Visibility Settings**.

> A **Visibility Settings** dialog box opens.

3.   Click the **Layer** tab.

4.   Click in the **Visible** and **Names** columns to switch the visibility of each element on or off.

Applying Color Information

Applying color information involves using the photos taken by the scanner when **Scan with Color** is enabled to add RGB values to the scan points. It may be best to apply color information right before you are ready to export, so that SCENE does not have to process the additional information during other operations.

You do not have to view scan data in a view to apply color information.

To apply color information, in the **Structure** window, right-click on a scan, multiple individual scans, or a cluster, and click **Operations** > **Color/Pictures** > **Apply Pictures**.

SCENE Dialog Box
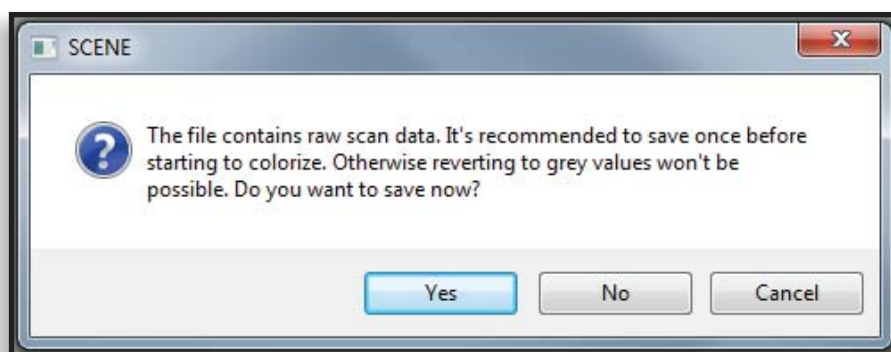
Hiding and Removing Color Information

If you have saved the project and then applied color information to scan data, you can hide or remove the color information.

To hide the color information:

1. In the menu bar, click **Butto**ns > **Options**.

2. Click the **Scan Data** tab.

3. Under **Scan color**, select **Use grey**.

To remove the color information:

1. In the **Structure** window, right click on a scan.

2. Click **Operations** > **Color/Pictures** > **Restore Grey Image**.

Scan Data Tab – Use Grey
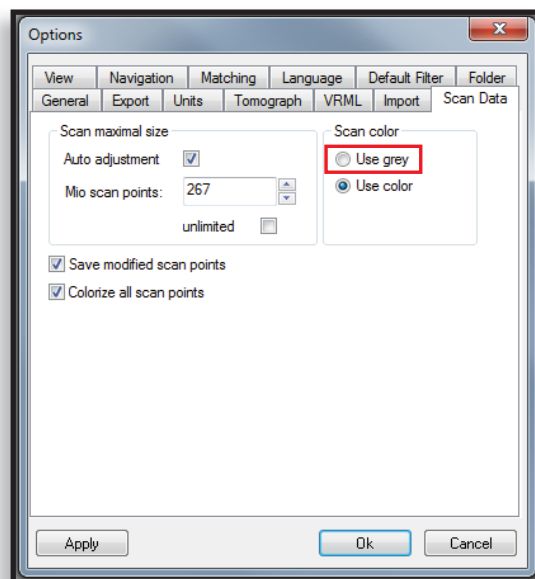
Refining the Color Information

Because lighting conditions vary from scan to scan, there may be abrupt changes in the color information. To even out the color, you can create a project point cloud.

To create a project point cloud, In the **Project Toolbar**, click **Create Project Point Cloud.**

In the **Project Point Cloud / Scan Point Cloud Settings** dialog box, select **Homogenize Point Density** and A**pply Color Balancing**.

Project Point Cloud / Scan Point Cloud Settings Dialog Box
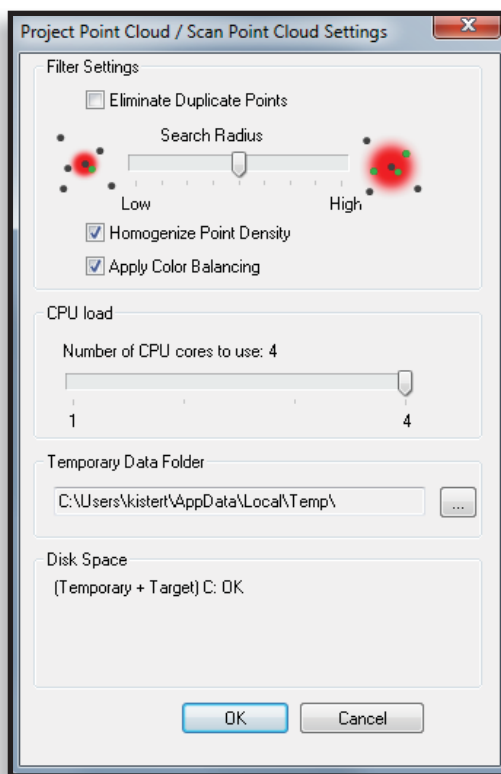
Before Creating a Project Point Cloud
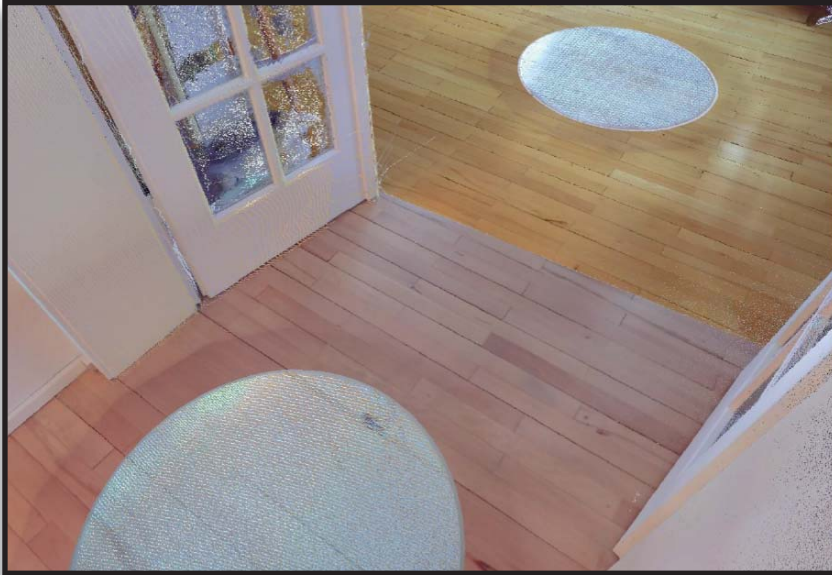
After Creating a Project Point Cloud
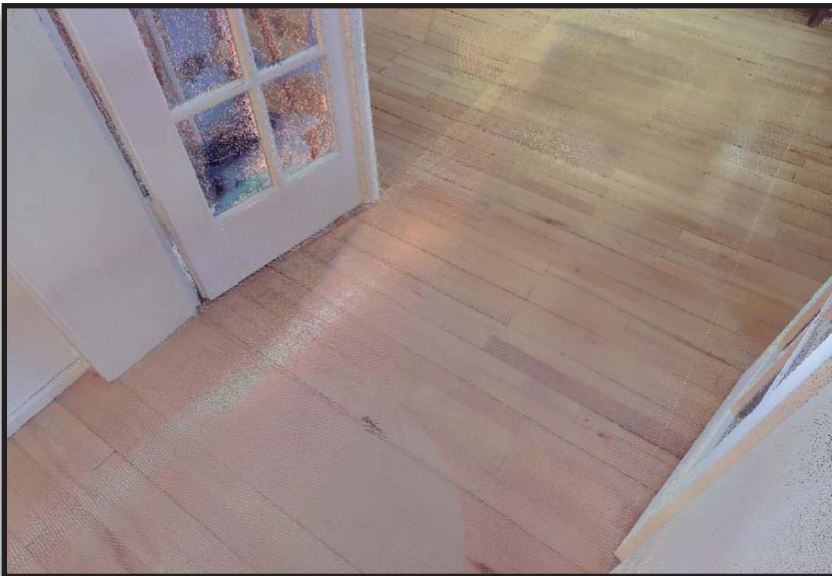
Scan State

To apply color information, scans must be loaded. It does not matter whether scan point clouds have been created or not.
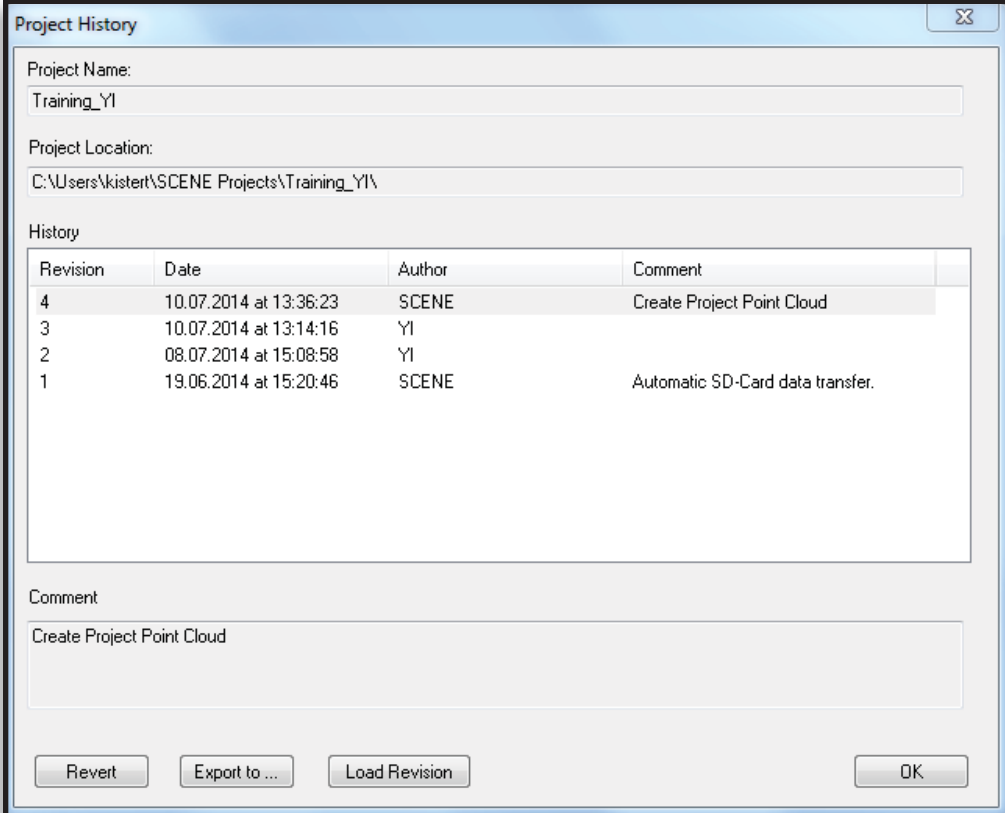
Saving

It is important to save before applying information, so you can remove the color information if necessary.

If you do not save before applying color information, a dialog box may appear, prompting you to save.

When you create a project point cloud, SCENE automatically saves a revision of the scan project with the comment **Create Project Point Cloud**, and SCENE listed as the **Author**.

Project History

Activity 6.5:
Applying Color Information

In this activity, you will practice applying color information.

Follow these steps:

1.   In the **Structure** window, right-click on a scan, multiple individual scans, or a cluster.

2.   Click **Operations** > **Color/Pictures** > **Apply Pictures**.

The **Colorize scan** dialog box appears, showing progress.

3.   Save.

4.   Create a project point cloud.

A.   In the **Project Toolbar**, click **Create Project Point Cloud.**

B.   The **Project Point Cloud / Scan Point Cloud Settings** dialog box appears.

C.   Select **Homogenize Point Density** and **Apply Color Balancing**.

5.   Click **OK**.

Lesson 4: Exporting

SCENE allows you to export scan data in several formats, now including AutoCad ReCap, to allow import into third-party software applications.

Scan State

The required scan state depends on the method used for exporting.

To export a scan or cluster in the **Structure** window:

1. Right-click on a scan and click **Import/Export** > **Export Scan Point**.

    ◦ Scan state: Any

Exporting a Scan from the Structure Window
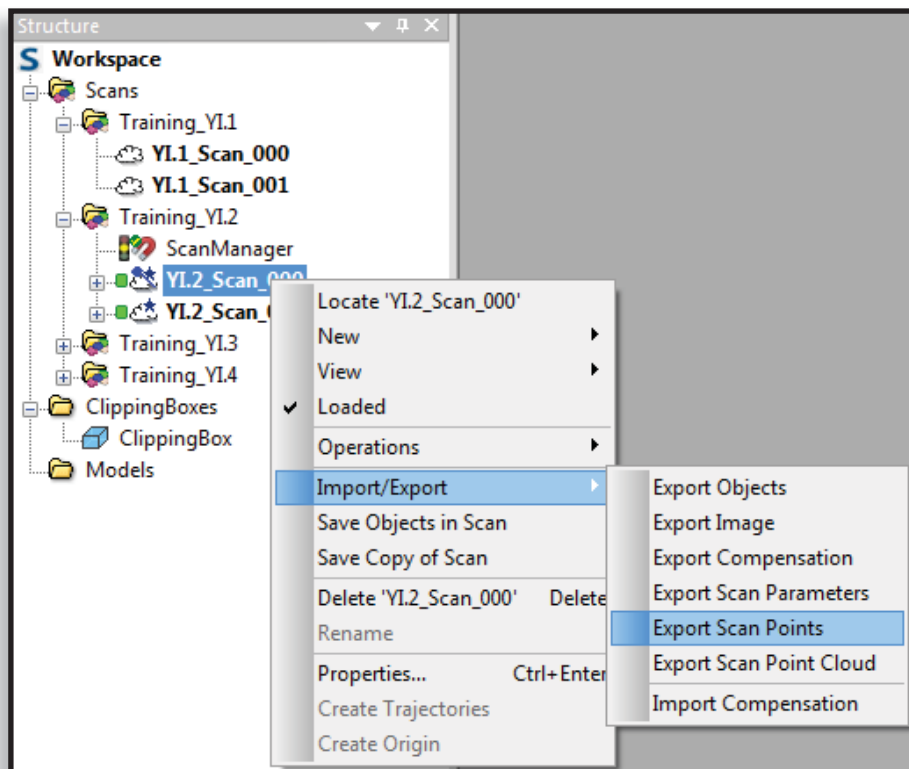
Exporting a Cluster from the Structure Window
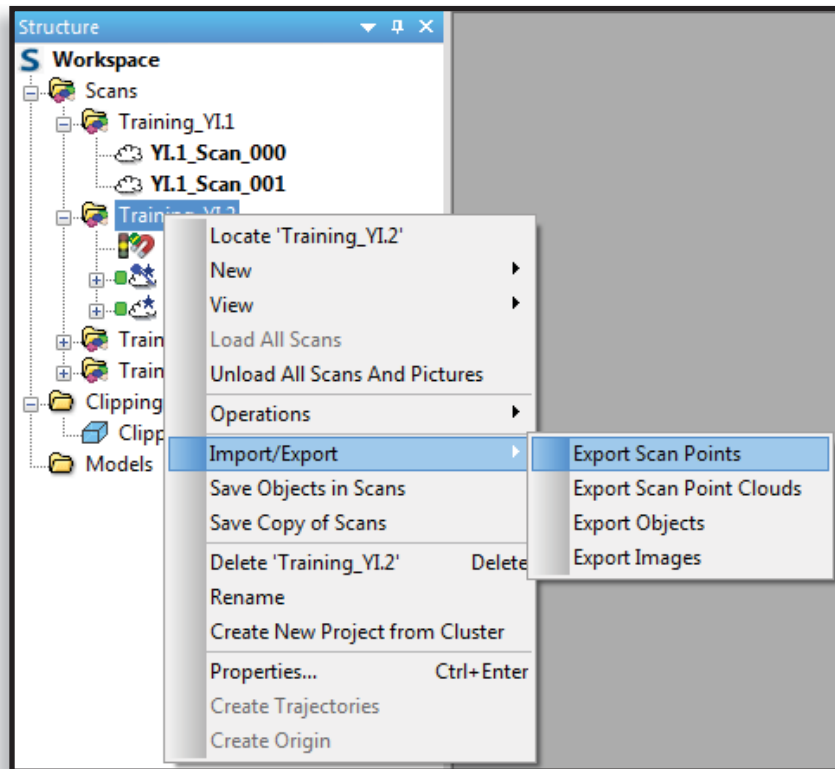
To export a scan in **Planar View:**

1. In the image area, right-click, then click **Direct Export** (exports with the most recent **Export Scan Point** settings) or **Export Scan Points** (opens the **Export Scan Points** dialog box)

2. Choose the format, filename, and location.

3. Click **Export**.

    ◦ Scan state: Loaded, without a scan point cloud

To export a selection of scan points in **Planar View:**

1. Right-click in a selection and click **Export** > **Direct Export** (exports using default or previously selected settings) or **Export Scan Points** (opens the **Export Scan Points** dialog box.

    ◦ Scan state: Loaded, with or without a scan point cloud

Exporting a Selection in Planar View
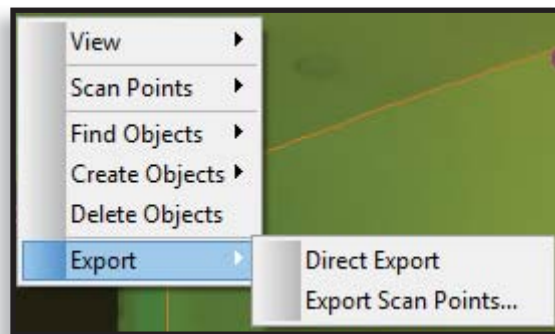
To export a selection of scan points in **3D View**

1. Use the **Point Cloud Polygon Selector** to make a selection.

2. Right-click on a selection and click **Export** > **3D Selection** or, in the image area or in the **Structure** window, right-click on a clipping box and click **Import/Export** > **Export 3D Selection using active Clipping Boxes**.

    ◦ Scan state: Unloaded, with a scan point cloud

To export a clipping box:

1. Open the scan containing the clipping box in **3D View**.

2. Right-click on the clipping box either in the **Structure** window or in the image area.

3. Click **Import/Export** > **Export 3D Selection using active Clipping Boxes**.

    ◦ Scan state: Unloaded, with a scan point cloud

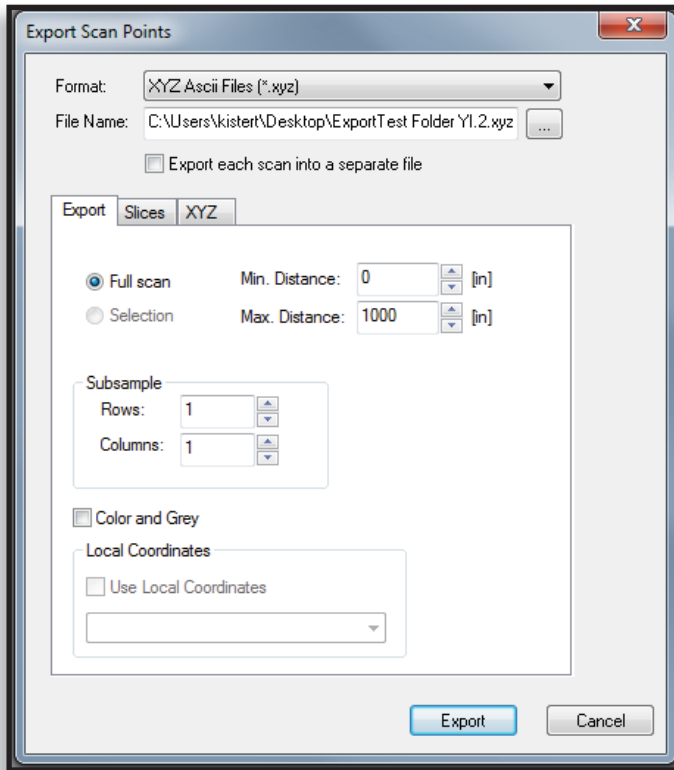**Exporting a Clipping Box in the Structure Window**
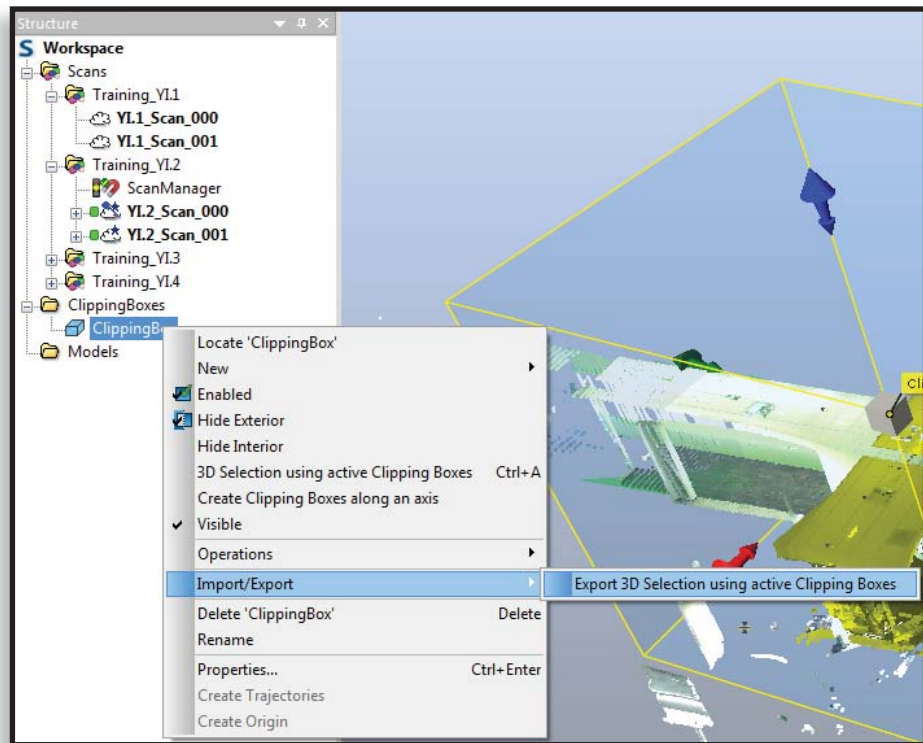
Troubleshooting
You must have the cluster containing the clipping box open in **3D View** to export a clipping box from the **Structure** window.

When you export, the **Export Scan Points** dialog box appears. The settings that are available in the dialog box depend on the type of process you use for exporting.

Export Scan Points Dialog Box

Activity 6.5:
Exporting

In this activity, you will practice exporting scan data in a clipping box.

Follow these steps:

1. Open the cluster in **3D View**.

2. Adjust the scan state so the scans are unloaded and have scan point clouds created.

3. In the **Structure** window, right-click on the clipping box that contains the scan data you want to export.

4. Click **Import/Export** > **Export 3D Selection using active Clipping Boxes**.

    The **Export Scan Points** dialog box appears.

5. Next to **Format:**, select the appropriate file format from the drop-down list.

6. Under **File Name:**, type in the path and file name or browse to the correct location and type in the file name.

7. Click **Export**.

    The **Exporting** dialog box appears.

Module Summary

This module explained the remaining steps in the Basic SCENE Workflow.

You should now be able to:

- Refine the registration.

- Ignore correspondences.

- Prepare data for exporting.

- Perform general cropping.

- Perform detail cropping.

- Use the Alignment command.

- Adjust Visibility settings.

- Apply color information.

- Hide or remove color information.

- Refine color information.

- Pulling Dimensions.

- Export scan data.

Module 7: Detail Scans

This module explains the steps involved in planning, capturing, and registering detail scans, as well as completing the steps of the basic registration workflow. Detail scans can provide an efficient and time-saving method for capturing data that meets project requirements.

This module contains two lessons:

- Lesson 1: Capturing a Detail Scan

- Lesson 2: Registering a Detail Scan

Lesson 1:
Capturing a Detail Scan

This lesson explains the steps involved in capturing a detail scan, and includes working with the scanner interface and planning. Capturing detail scans can save time and ensure that enough data is captured to meet project requirements.

Learning objectives:

- Practice the Detail with an Overview scanning strategy.

- Determine **Scan Duration** for detail scans.

- Capture an additional full scan.

Overview

A detail scan contains only a portion of the scan area and is usually at a higher resolution than a full scan. In some situations, you may need to capture a detailed area or object, rather than, or in addition to, capturing a full scan.

The advantages of capturing detail scans include:

- Files are smaller and require fewer computer resources.

- **Scan Duration** is shorter.

To capture a detail scan, from the **Home** screen, tap **Parameters** > **Horizontal Vertical**. This opens the **Scan Area** screen.

The **Vertical Area** and **Horizontal Area** display the angles of the outside edges of the scan area. The outside edges of the default area, which is a full scan, are at -60° (bottom edge), 90° (top edge), 0° (left edge), and 360° (right edge).

To capture a detail scan, change the angles to move the outside edges of the scan area. To change the angles, use the arrows to move the edges incrementally, or tap one of the blue degree buttons to enter numeric values using the on-screen keyboard.

FARO

To reset the scan area to a full scan, tap **Default Area**.

Scan Area Screen
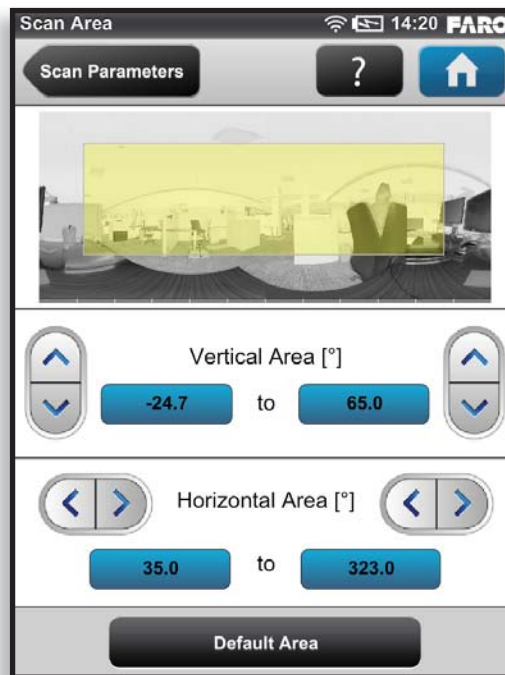
When working with a detail scan, it is important to take an overview scan, and then capture the detail scan without moving the scanner. The full scan is referred to as the **overview** scan.

Activity 7.1:
Detail Scan Duration

In this activity, you will adjust the **Scan Area** settings and note how these settings affect **Scan Duration**.

Given a **Resolution** setting of 1/4, a **Quality** setting of 4x, **Scan with Color** off, and the **Vertical Area** and **Horizontal Area** in the table, determine the **Scan Duration** of each of the following detail scans without color.

Follow these steps:

1. Adjust the **Resolution** and **Quality** settings.

   A. From the **Home** screen, tap **Parameters** > **Resolution [MPts] Quality**.

   B. Use the sliders, or the buttons above and below the sliders, to adjust the **Resolution** setting to **1/4** and the **Quality** setting to **4x**.

2. Adjust the **Scan Area.**

   A. At the top of the screen, tap **Scan Parameters**.

   B. Tap **Horizontal Vertical**.

   C. Use the arrows, or tap on a blue degree button, to adjust the **Vertical Area** and **Horizontal Area**.

3. Note the **Scan Duration**.

    A. Tap **Scan Parameters**.

    B. Tap **Resolution [MPts] Quality**.

    C. The **Scan Duration** is displayed in the middle of the screen.

    D. Fill in the **Scan Duration** column in the table.

Vertical Area	Horizontal Area	Scan Duration [mm:ss]*
-60.0° to 90.0°	0.0° to 360.0°	
-60.0° to 90.0°	0.0° to 180.0°	
-60.0° to 90.0°	45.0° to 135.0°	
-60.0° to 45.0°	45.0° to 135.0°	
*The scan durations are approximate and are based on values displayed on the **Resolution / Quality** screen on the Focus[3D] X 330, when viewed using **Administration View** in SCENE Version 5.2.6.36760.		

Activity 7.2:
Capturing a Detail Scan

In this activity, you will practice the basic workflow for the Detail with an Overview scan strategy. You will capture two full scans and one detail scan.

Follow these steps:

1. Create a site sketch.

    A. Select an object of interest within the scan area to capture with a detail scan.

    B. Add scanner positions to the site sketch.

    C. Add target arrangements to the site sketch.

2. If you are using targets, arrange and mount the targets in the scan area.

3. Set the parameters for the first scan.

4. Make sure the correct subproject is selected so that the captured scan data will have the correct name.

    A. Tap **Manage** > **Projects**.

    B. Tap the subproject so it is highlighted.

    C. Tap **Home**.

5. Capture the first scan.

   A. Move the scanner to the first scanner position.

   B. If necessary, use the inclinometer to make sure the scanner is level.

      I. Tap **Manage** > **Sensors**.

      II. Adjust the tripod legs so the yellow dot is in the center of the large circle.

      III. Tap **Home**.

   C. Tap **Start Scan**.

6. Capture the second scan.

   A. Move the scanner to the second scanner position.

   B. If necessary, use the inclinometer to make sure the scanner is level.

   C. Tap **Start Scan**.

7. Capture the detail scan.

   Do not move the scanner between the second and third scan.

   A. Adjust the **Scan Area.**

      I. At the top of the screen, tap **Scan Parameters**.

      II. Tap **Horizontal Vertical**.

      III. Use the arrows, or tap on a blue degree button, to adjust the **Vertical Area** and **Horizontal Area**.

      IV. Tap **Home**.

   B. Tap **Start Scan**.

8. When the detail scan is complete, tap **Home**.

Lesson 2:
Registering a Detail Scan

This lesson explains the steps involved in registering a detail scan with two full scans, one of which is the associated overview scan. Understanding and practicing these steps can save time and ensure that the project is executed efficiently and meets project requirements.

Learning objectives:

- Fix (lock) the detail scan.

- Register the two full scans automatically.

- Unfix (unlock) the detail scan.

- Register the detail scan with the overview scan.

- Complete the workflow for registration.

Overview

When working with detail scans, it is best to complete the registration process for all of the other scans before registering the detail scan. You can do this by fixing (or locking) the detail scan, and then using either automatic or manual registration. After registering the other scans, you can release the detail scan and register it with the associated overview scan.

You can fix the detail scan by opening the **Properties** dialog box and, on the **Scan** tab, selecting **Scan Fixed**.

Before registering the detail scan, you must designate one of the full scans as the reference scan. This is also done on the **Scan Fixed** tab of the **Properties** dialog box.

When registering detail scans with the overview scan, it is easiest to simply copy and paste the x, y, and z coordinates for both the **Position** and **Rot. Angle** from the overview scan to the detail scan.

You can view the coordinates by opening the **Properties** dialog box for each scan and clicking the **Transformation** tab.

Transformation Tabs
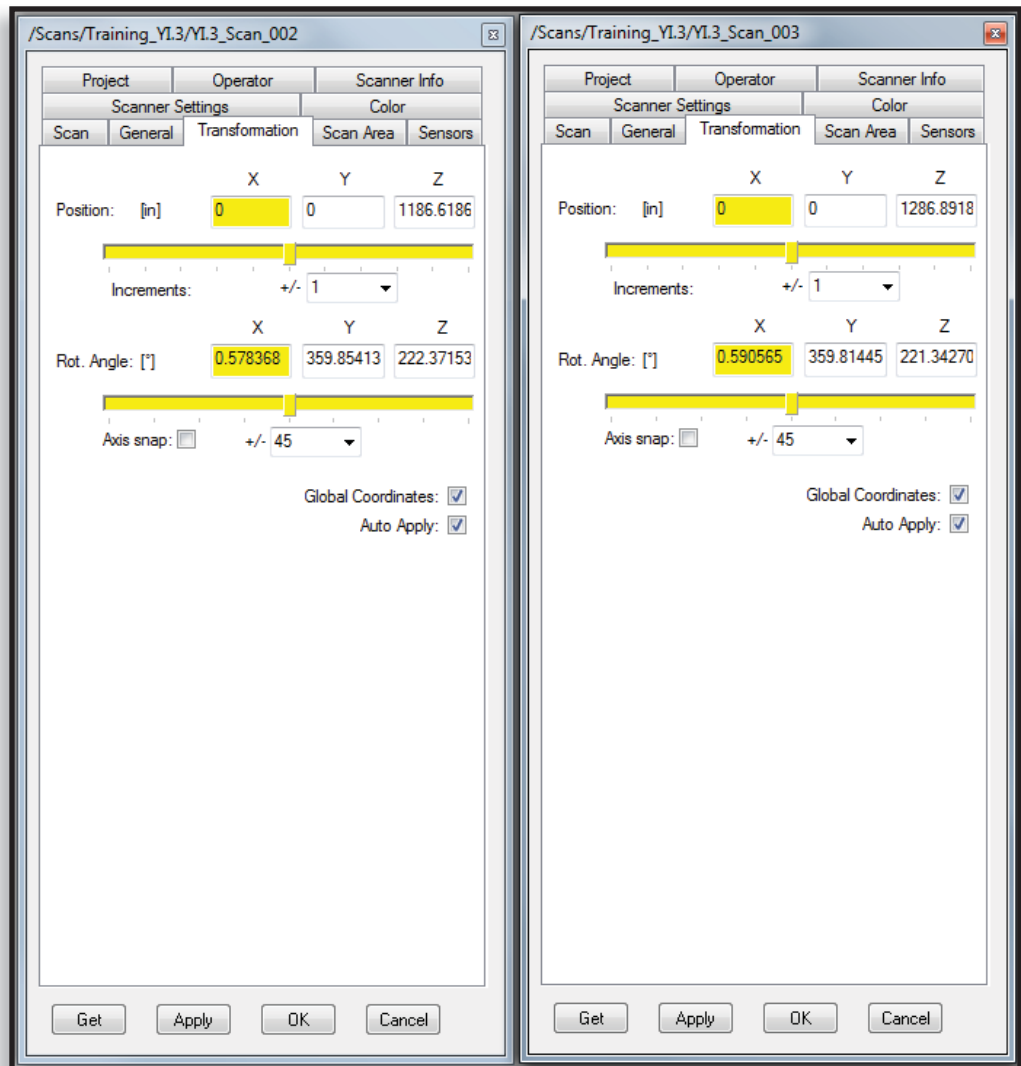
Activity 7.3:
Fixing the Detail Scan

In this activity, you will fix the detail scan so that you can automatically register the full scans.

Follow these steps:

1. Verify that you are working with the detail scan.

   A. In the **Structure** window, right-click on the detail scan (**Training_[*Your Initials*].2_Scan_002**).

   B. Click **Properties**.

2. Click the **Scan Area** tab.

   A. Verify that the **Vertical** and **Horizontal** values and the **Resolution** and **Quality** settings match those set on the scanner for the detail scan.

3. Fix (or lock) the scan.

   A. Click the **Scan** tab.

   B. Select **Scan Fixed:**.

   C. Click **OK**.

   > The icon in the **Structure** window shows a red line through the cloud.

Activity 7.4:
Automatic Registration – Full Scans

In this activity, you will automatically register the two full scans in **First_Project[Your Initials].3.**

Follow these steps:

1. Designate one of the full scans as the reference scan.

    A. In the **Structure** window, right-click on one of the full scans, and click **Properties**.

    B. On the **Scan** tab, select **Reference Scan**.

    C. Click **OK**.

2. Fix the detail scan.

    A. In the **Structure** window, right-click on one of the full scans, and click **Properties**.

    B. On the **Scan** tab, select **Scan Fixed**.

    C. Click **OK**.

3. Register using the **Top View Based** configuration.

    A. In the **Structure** window, right-click on the folder.

    B. Click **Operations** > **Preprocessing** > **Preprocess Scan**.

    C. Select **Place Scans**, clear all other check boxes, then click **Configure**.

    D. On the drop-down menu, click **Top View Based**.

    E. Click **OK**.

    F. Click **OK**.

4. Save.

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Activity 7.5:
Registering the Detail Scan

In this activity, you will register the detail scan with the overview scan, and complete the basic workflow.

Follow these steps:

1. Unfix (unlock) the detail scan.

    A. Right-click on the detail scan (**First_Project_[***Your Initials***].2_Scan_002**).

    B. Click **Properties**.

    C. In the **Scan** tab, clear **Scan Fixed**.

    D. Click **OK**.

2. Register the detail scan with the associated overview scan.

    A. View the *x*, *y*, and *z* coordinates of both the overview scan and the detail scan.

        I. In the **Structure** window, right-click on each scan.

        II. Click **Properties**.

        III. Click the **Transformation** tab.

    B. Move the two dialog boxes side by side.

C. Copy the three *x*, *y*, and *z* values for **Position** and **Rot. Angle** (six values in total) from the dialog box for the overview scan into the corresponding fields in the dialog box for the detail scan.

    I. Place the cursor in each field, and, using the keyboard, press **Ctrl A** (**Select All**), then **Ctrl C** (**Copy**).

    II. Place the cursor in the corresponding field and, using the keyboard, press **Ctrl A**, then **Ctrl V** (**Paste**).

        Using the keyboard shortcuts ensures that all characters are selected, including any negative signs.

D. Click **OK** in both dialog boxes.

3. Save.

4. Continue with the basic workflow:

A. Inspect.

B. Refine.

C. Prepare for export.

D. Export.

Module Summary

This module explained the steps involved in planning, capturing, and registering detail scans, as well as completing the steps of the basic registration workflow. Detail scans can provide an efficient and time-saving method for capturing data that meets project requirements.

You should be able to:

- Practice the Detail with an Overview scanning strategy.

- Determine **Scan Duration** for detail scans.

- Capture an additional full scan.

- Fix (lock) the detail scan.

- Register the two full scans automatically.

- Unfix (unlock) the detail scan.

- Register the detail scan with the overview scan.

- Complete the workflow for registration.

Appendix 1:
Activity Answers

Activity 1.2
Using the Scanner Interface

Using the scanner interface, answer the following questions:

1. Where is the battery status shown?

   The battery status is displayed as percent charged in two places:

   - Under **Manage** > **General Settings** > **Power Management** > **Battery Charge State**

   - In the status bar

2. How many date formats are available?

   There are three date formats, which are available under **Manage** > **General Settings** > **Date & Time** > **Select Date Format**, and are:

   - **DD.MM.YYYY**

   - **MM/DD/YYYY**

   - **YYYY-MM-DD**

3. Where can you access the inclinometer?

   The inclinometer can be accessed in two places:

   - Under **Parameters** > **Select Sensors**

   - Under **Manage** > **Sensors**

4. What screen allows you to update the firmware?

   The firmware can be updated by selecting **Manage** > **Service** > **Firmware Update**. The update must be saved on the SD card.

5. Where can customer support information be found?

   Customer support information can be found under *Manage* > *Service* > *Customer Support*.

6. What information can be entered for an operator?

   The following can be entered for an operator:

   - **Name**
   - **Company**
   - **Department**
   - **Phone**
   - **Email**
   - **Info**

7. What information can be entered for projects?

   Project information can be entered by tapping **Manage** > **Projects,** and includes:

   - **Project Name**
   - **Parent Project**
   - **Customer**
   - **File Base Name**
   - **Initial Scan No.**
   - **Additional Info**
   - **Latitude**

Activity 1.3
Resolution and Quality

Given the settings in the table, determine the **Scan Duration** and **Point Distance** and write the values in the table.

Resolution Setting	Quality Setting	Scan with Color	Scan Duration [hh:mm:ss]*	Point Distance	
				[mm at 10 m]	[in at 30 ft]
1/1	4x	Off	01:55:00	1.534	0.055
1/1	4x	On	01:58:00	1.534	0.055
1/4	4x	Off	00:08:09	6.136	0.221
1/4	4x	On	00:11:15	6.136	0.221
1/4	8x	Off	01:55:00	6.136	0.221
1/4	8x	On	01:58:00	6.136	0.221
1/8	4x	Off	00:02:47	12.272	0.442
1/8	4x	On	00:05:53	12.272	0.442
1/8	2x	Off	00:01:26	12.272	0.442
1/8	2x	On	00:04:32	12.272	0.442

*When the **Scan Duration** is greater than an hour, seconds are not displayed; the format changes from **mm:ss** to **hh:mm**. The scan durations are approximate and are based on values displayed on the **Resolution / Quality** screen on the Focus3D X 330.

Appendix 2:
Accuracy Verification

In some fields, such as law enforcement, verifying the accuracy of the scanner to a reasonable degree of certainty, referred to as an accuracy confirmation check, is critical. This can be done using scale objects.

Scale Objects

Scale object are objects such as rulers, yardsticks, or any accepted standard measurement indicator. Features within the scan area with known, verifiable measurements, such as windows and doors, can also be used as scale objects.

The Pythagorean theorem ($a^2 + b^2 = c^2$) is used to obtain the distance between two points.

The Pythagorean theorem is based on three elements:

- Vertical distance (a)

- Horizontal distance (b)

- Slope distance, or hypotenuse (c)
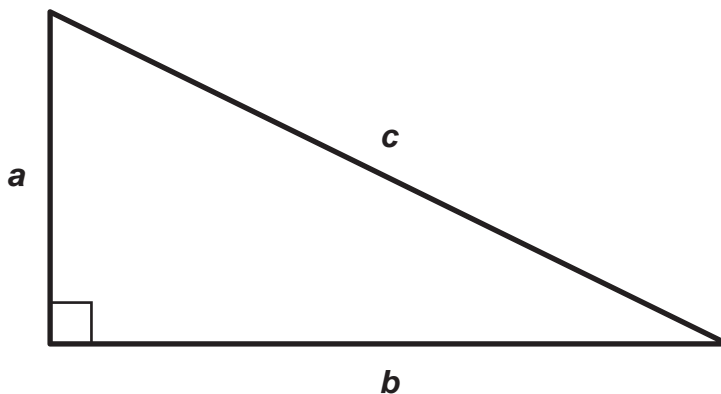
To successfully verify accuracy, ensure:

- The scale object is placed at a sufficient angle to the scanner (at least ten degrees). The scale object should not be placed perpendicular to the scanner.

- The scale object is placed close enough to the scanner so that the measurement units can be adequately captured and are readable.

Each situation will call for different types of scale objects and different placements, based on factors such as whether the scan is indoors or outdoors, the types of scale objects available, etc.

Appendix 3: Glossary

accuracy – The closeness of a measurement to actual dimensions

cluster – a folder in SCENE that contains scans

common reference object – Objects common to two or more scans, to which a correspondence can be assigned and can be used to align the scans during registration.

coordinate system – A system that uses one or more variables (such as x, y, and z), or coordinates, to determine the unique position of a point or other geometric element in space

correspondence – The relationship between the same common reference object in multiple scans

error – The difference between a measurement and actual dimensions

fit – How well points match a corresponding object

match – How SCENE registers a constellation of objects in one scan to a constellation in another scan

origin – The point at which scan data originates, used as a fixed reference point for the surrounding scan data; the point where the axes of a coordinate system intersect

placing scans – In SCENE, synonymous with registering scans

point cloud – The three-dimensional computer visualization of scan points within x, y, and z coordinates

precision – The probability of obtaining the same results from a repeated measurement

preprocessing – In SCENE, automatic registration, which includes several other operations.

profile – A collection of scan parameters, such as **Resolution** and **Quality** settings, **Scan with Color**, **Scan Area**, etc.

Project – The combination of all files, folders, objects, data, and other elements involved in capturing, processing, and analyzing scans

quality – the amount of noise, or the number of extraneous unwanted points, in a scan

reference scan – the scan to which all other scans included in the registration are aligned

reflectance – the measure of laser light reflected off a surface

registration – the process of aligning multiple individual scans onto a single coordinate system

resolution – the sharpness, or the fineness of detail, in a scan

scan – collection of data points that represent physical measurements taken by the scanner; also refers to the process of capturing scan data

tension – The discrepancy between the position and the orientation of two corresponding common reference objects within the overall coordinate system.

workspace – A combination of all files, folders, objects, data, and other elements that allows SCENE to optimize your computer's performance. Local workspace data is linked to the original data, so you can perform certain operations without duplicating scan data.

Icon Glossary

The following table includes many of the icons that appear in the **Structure** window.

Icons in the Structure Window

Icon	Meaning
Folders	
	Cluster
	Fixed Cluster
	Reference Cluster
	Folder
	Mesh Folder
Scans	
	Scan
	Scan with Scan Point Cloud
	Modified Scan
	Reference Scan
	Fixed Scan
	Loading Scan
	Loaded Scan
	Reduced-Size Loaded Scan
Registration/Correspondence Status	
	Good
	Medium
	Poor
	Active
	Inactive
Correspondences	

Icon	Meaning
c	**Automatic Correspondence**
R	**Ignored Correspondence**
c	**Forced Correspondence**
Objects	
	Checkerboard
	Circular, Flat Target
	Contrast Mean Point
	Document
	Expanded Plane
	Line
	Mean Point
	Mesh
	Pipe
	Plane
	Point
	Region
	Scan Point
	Slab
	Sphere
	Sphere Radius
Miscellaneous	
G	Global Origin
?	Missing Element
	Picture

Icon	Meaning
	Viewpoint
	Virtual Scan (High-Resolution, Imported Picture)

Basic SCENE Workflow

1. Import scan data and open the scan project.

Insert the SD card.

Open the scan project.

2. Register.

Register automatically
(preprocess).

Register manually
(identify objects).

Save.

3. Inspect the registration.

Inspect using 3D View.

Inspect using the ScanManager.

Use clipping boxes, as needed.

4. Refine the registration.

Remove correspondences with the highest tension values.

Update the ScanManager.

Repeat as needed.

Save.

5. Prepare for exporting.

Adjust the alignment.

Create a project point cloud.

Crop scan data.

Create clipping boxes.

Apply color information.

Adjust the Visibility Settings.

6. Export.

Automatic Registration Workflow

1. Select preprocessing settings.

> Click Operations > Preprocessing > Process Scans.

> Select which types of common reference object to identify.

> Select Place Scans.

2. Select a registration configuration.

> Click Configure.

| Target Based Registration | Top View Based Registration | Cloud to Cloud Registration |

> Save.

Manual Registration Workflow

1. Open two scans in Correspondence Split View.

> **Click the Create Correspondence Split View button.**
>
> ↓
>
> **Drag each scan into a Correspondence Split View window.**
>
> ↓
>
> **In the Structure window, expand the file structure of each scan.**

2. Identify at least three common reference objects.

> **Navigate to the same object in both scans.**
>
> ↓ ↓ ↓
>
> | **Use the Mark tools.** | **Use the Create Objects command.** | **Use the Find Objects command.** |
>
> ↓
>
> **Verify the precision of identified common reference objects as needed.**
>
> ↓
>
> **Click the Force current correspondences between shown scans button.**
>
> ↓
>
> **Save.**

3. Register.

> **Preprocess.** → **Configure (Target Based).** → **Save.**