AVEVA™

**LFM Gateway Mode**
**Data Preparation and Registration Help Guide**

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# LFM Gateway Mode
# Data Preparation and Registration Help Guide

**Contents**                                                             **Page**

# 1      Preface

This chapter gives basic information about this guide, training and support.

## 1.1      About this Guide

This guide describes how to register scan data in the Gateway mode.

## 1.2      Audience

This set of documentation is aimed at new users and covers the use of AVEVA LFM Server: Gateway Mode, Server Mode, its associated CAD links and production of AVEVA LFM related resources such as HyperBubble data, Solid Pointcloud data and AVEVA LFM NetView projects. The contents cover operations for both Engineering Users and Project Administrators. It is assumed that the user already has *AVEVA LFM Server* installed and has the appropriate license features available.

## 1.3    Related Documents

Other related documents include:

- **AVEVA LFM Server - Autodesk AutoCAD Interface**

    Also covers AutoCAD MEP, CADWorx and Bentley AutoPLANT

- **AVEVA LFM Server – Autodesk Navisworks Interface**

- **AVEVA LFM Server – Autodesk Revit Interface**

- **AVEVA LFM Server - Aveva PDMS CAD Interface**

- **AVEVA LFM Server - Aveva Review CAD Interface**

- **AVEVA LFM Server - Bentley MicroStation CAD Interface**

    Also covers Bentley ConstructSim

- **AVEVA LFM Server - Intergraph PDS CAD Interface**

- **AVEVA LFM Server - Intergraph SmartPlant 3D CAD Interface**

- **AVEVA LFM Server - Intergraph SmartPlant Review CAD Interface**

- **AVEVA LFM Server - COMOS Walkinside CAD Interface**

- **AVEVA LFM Server - Quick Start Guide**

    The AVEVA LFM Server Quick Start Guide is not intended to cover every aspect of this package, but should provide designers with a 3D CAD background a quick introduction to common features and typical project requirements.

- **AVEVA LFM NetView Project Publishing Guide**

    This guide covers the creation and deployment of an AVEVA LFM NetView project from the point that the AVEVA LFM Server dataset (.lfd) is available up until, and including the point where the VHD is created.

- **HyperBubble and Solid Point Cloud Creation and Use Guide**

    This guide covers everything related to the new HyperBubble feature including pre-requisites, publishing and use.

**Note:** These documents can be accessed by opening the file browser and browsing to the location where *AVEVA LFM Server* is installed. By default, they are available at the following location:

**C:\Program Files\LFM Software\LFM\helpfiles**

## 1.4     Technical Support

Online support and more information about *AVEVA LFM* should be requested through lfm.support@aveva.com.

To aid fault diagnosis, please include the following information when contacting AVEVA LFM Support:

- Urgency

- Full version number of *AVEVA LFM Server*

- Information about any CAD package being connected to (including full version number)

- AVEVA LFM Server log files. To obtain these, go to the **File** > **Home** tab and click the **Copy Log Files** button. This copies a series of 5 text files to the location of your choice. These will be called `lfmServerRunA.log` – `lfmServerRunE.log`. Please send all 5 files.

### AVEVA LFM Upgrades

Upgrades can be downloaded from the AVEVA LFM Software website from https://www.aveva.com/en/Services_and_Support/AVEVA_Product_Support/#LFM -Support.

## 1.5     Product and Training Information

For general information and commercial enquiries, please contact lfm.info@aveva.com.

For information about product training courses, see the Product Training section of AVEVA's website (http://www.aveva.com/training), or contact the nearest AVEVA Regional Support Centre (http://support.aveva.com/support).

# 2      Project Setup and Data Conversion

Data conversion is integrated into the AVEVA LFM Server Gateway Mode interface. After the scans have been added to the project the conversion seamlessly starts in the background. Scans are processed in parallel according to the amount of memory available on the machine (1 conversion per 4GB RAM). After a scan has finished converting, it can be used instantly. There is no need to wait for the other scans to finish converting.

Scan formats that can be used in AVEVA LFM Server Gateway Mode are listed below:

- .zfs
- .zfc
- .ptx
- .ptz
- .pts (points only)
- .fls
- .fws
- .3dd
- .rxp
- .tzf
- .rsp
- .prj
- .las (points only)
- .laz (points only)
- .dp (points only)
- .e57 (structured and unstructured)
- .mvx (Mantis)
- .cl3 (Topcon)

AVEVA LFM Server Gateway Mode supports the addition of colour to laser scan data in .jpg, .png or .nctri (iSTAR) formats, and the import of standalone panoramic pictures in .jpg and .png formats.

**Note:** You must run the application in the Advanced mode to be able to import Mantis scan data.

**Note:** For .prj files, the appropriate hardware license is required on the scanner to be able to import these files into third party software, such as AVEVA LFM Server Gateway Mode. Please contact your local Leica representative for more information.

## 2.1  Workflow

The workflow for data conversion is described in the following steps:

1.  Start *AVEVA LFM Server* by double-clicking on the desktop shortcut.

2.  After the interface has loaded, check if you are in Gateway mode. The current mode is shown at the top-right corner of the interface. If you are in Server mode, switch to Gateway mode by clicking the drop-down arrow at the top-right corner of the AVEVA LFM Server interface and select **Gateway**.

3.  When in Gateway mode, click **File** and select **New Project**. This opens a browser window.

4.  Specify the project location and name, then click **Save**.
    **Note:** For colour scans, please ensure the colour panoramic .jpg or .png files are in the same location as the source scans before proceeding with the steps below. The .jpg or .png must be named the same as the scan name with "_color" at the end (For example, Scan1_color.jpg).

5.  In the **Registration** panel, right-click the project and select **Import to this project**. This opens a browser.

6.  Select the scans to be added and click **Open**.

7.  Alternatively, select the scans to be added in a Windows Explorer window and drag and drop them on to the project node. This brings up the Conversion options dialogue shown below:
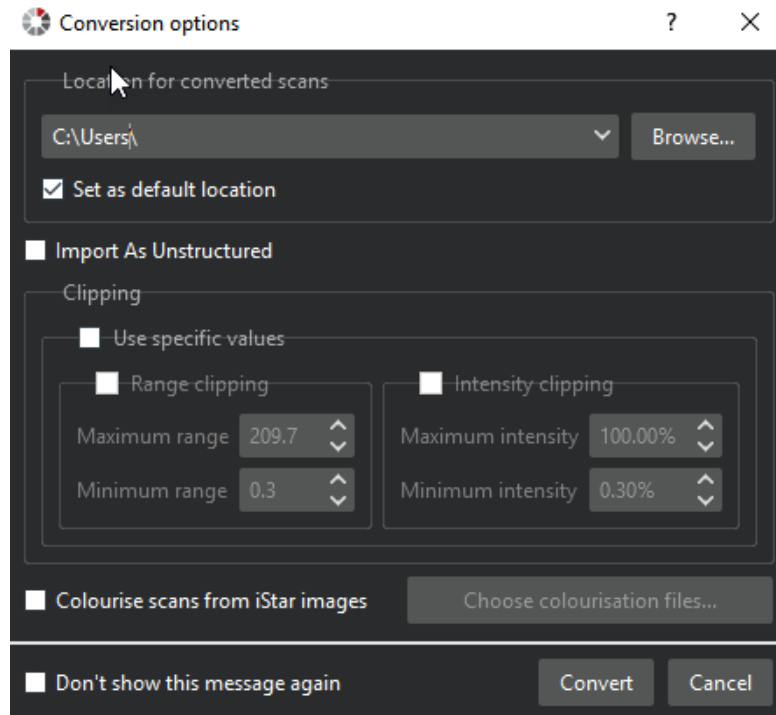


**Note:** If you are importing partial scans, select only the parent full scans. If the partial scans are in the same folder as the parent full scans, the partial scans are automatically imported by *AVEVA LFM Server*.

8.  Select the desired location for the converted scans. By default this will be the same folder as the .lfm file location.

9.  To add colour to scans from an iSTAR camera (through an .nctri file), select **Colourise scans from iStar images**.

10. Then click **Choose colourisation files**. The dialogue shown below appears.
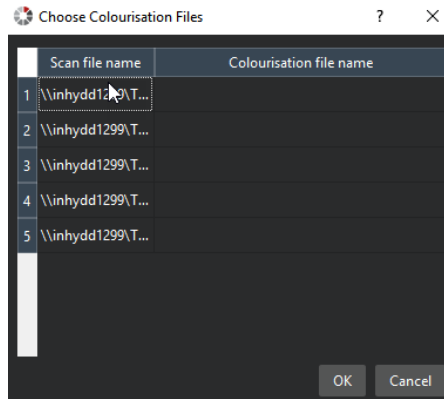


11. Click on each scan to select the corresponding .nctri file. Then click **OK** when done.

12. Click **Convert** on the Conversion Options dialogue after the appropriate options have been set. The scans automatically start to convert. After a scan has finished converting, its status is shown as **Complete**.
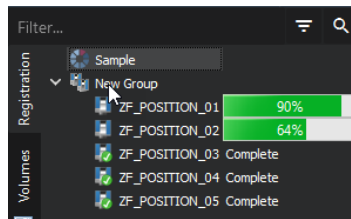


The progress of the conversion is displayed at the bottom-right corner of the Gateway interface.
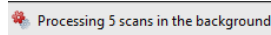


 **Note:** If the data being imported is unstructured, .ptx data, enable the **Import As Unstructured** box. Ptx files should be formatted as shown below:

## 2.2 Importing LAS (.las/.laz) Data

LAS is a commonly used data format to deliver Lidar data captured using techniques such as airborne or mobile data capture systems. As these data capture mechanisms are used during the capture of large geographic areas, it is normal to capture the data in a geo-referenced form. This geo-referenced information can either be embedded within the LAS file as metadata or added during the import process within the AVEVA LFM Server Gateway Mode interface. AVEVA LFM Server Gateway Mode accepts both geo-referenced and non-georeferenced LAS data.

For geo-referenced data in a specified map projection, to avoid any issues with multiple LAS scans in different projects when the LAS data is loaded into AVEVA LFM Server Gateway Mode, the data will be re-projected into an Earth Centred Earth Fixed (ECEF) Cartesian co-ordinate system.

### 2.2.1 Earth Centred Earth Fixed (ECEF)

Rather than using a projection system where points in the scan data are projected onto a flat surface for the production of maps, using ECEF co-ordinates allows the data to be mapped on to a spherical body which is representative of the Earth's surface. This allows *AVEVA LFM Server* users to seamlessly use multiple LAS scans within a single project or dataset.
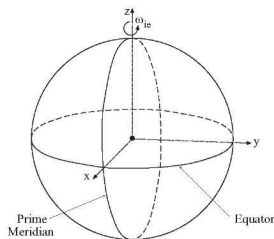


### 2.2.2 Import Process

The import process is as described below:

1. In the **Registration** panel, right-click the project and select **Import to this project**. This opens a browser.

2. Select the LAS files to be added and click **Open**.

3. Alternatively, select the LAS files to be added in a Windows Explorer window and drag and drop them onto the project node.

Having selected the data to be imported, the Conversion Options dialog is displayed. This enables the user to interrogate the metadata for each file and set the appropriate source projection system if needed.
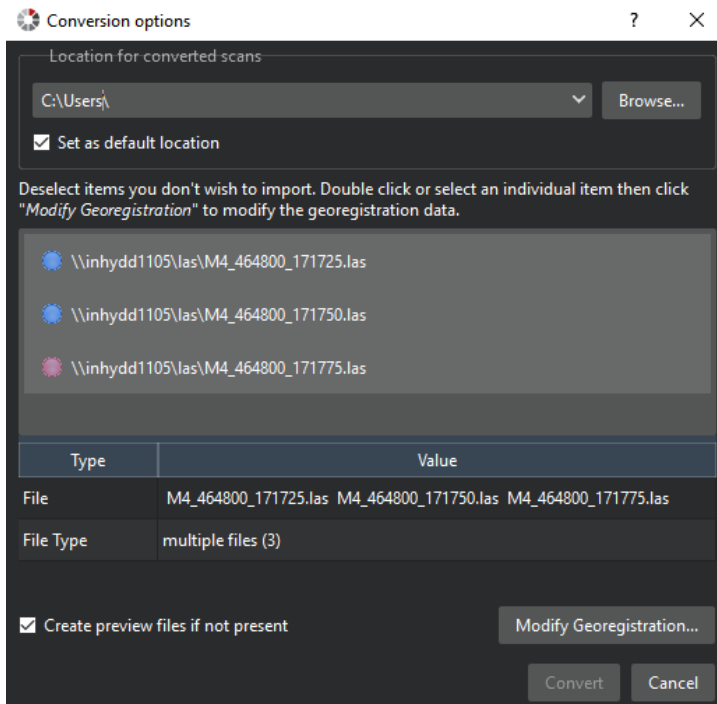


All the scans listed have one of the following icons that signify the registration type:

- Blue - Georegistered
- Green - Plant space
- Red - Unregistered

The following image displays the different types of icons for each registration type:



**Note:** Before loading the scan data, it must be either geo-registered or in plant space, and must be of the same registration type.

### 2.2.3 Metadata

Selecting one of the LAS files within the interface displays the metadata stored within that file in the lower part of the dialog, if it is available. This metadata is optional and will be completed by the service provider that generated the data. When multiple files are selected, the metadata interface displays the list of all the files selected and the number of files selected. Displaying the number of files selected helps ensure the number of files in the interface is as expected, as when selecting thousands of source files it can be difficult to verify if all the files are selected.

| Type | Value |
|---|---|
| File Name | stadium-utm |
| File Type | LAZ |
|  |  |
| LAS Version | 1.2 |
| Project GUID | 1729464643-21321-17479-4394-1849DEF4CD7F |
| System Identifier | PDAL |
| Generat...oftware | PDAL 0.1.0 |
| File Creation Date | 198/2013 |
| Total Points | The files reports 484781 points, contents estimate 693895 |
| Extent Min | 494367.91, 4878180.65, 126.64 |

The registration type within this section of the dialog provides the projection information within the metadata if specified. If you do not set the projection information, the field will be missing from the interface and it will be necessary to set this directly for the data using the **Modify Georegistration** button. The provider of the data will be able to supply details of the geo-registration codes to use.

| Registration | Plant space |
|---|---|
| GT Citation | Arbitrary (m) |
| Horizontal Units | metre |
| Vertical Units | metre |
| Proj.4 code | +units=m |

| Registration | Georegisterd |
|---|---|
| Projected CS | WGS 84 / UTM zone 31N |
| Geographic Citation | WGS 84 |
| WKT Projected CS | WGS84 / UTM zone 31N |
| WKT Projection | Transverse_Mercator |
| WKT Geographic CS | WGS 84 |
| Horizontal Units | metre |
| Vertical Units | metre |
| Proj.4 code | +init=epsg:32631 |

The geo-registration code (to specify the projection of geographic coordinate system) is based on the IOGP EPSG Geodetic Parameter Dataset. This is a collection of definitions of coordinate reference systems and coordinate transformations which may be global, regional, national or local in application (see http://www.epsg.org/). The list of EPSG codes is extensive, there are additional codes such as the ESRI spatial reference codes. Whilst these codes cannot be directly entered through the .las import interface, it is possible to enter the Proj.4 definitions for a spatial reference code. In this case select the **Proj.4** toggle within the interface (highlighted below) and enter the code. A good source of spatial reference codes is http://spatialreference.org/.
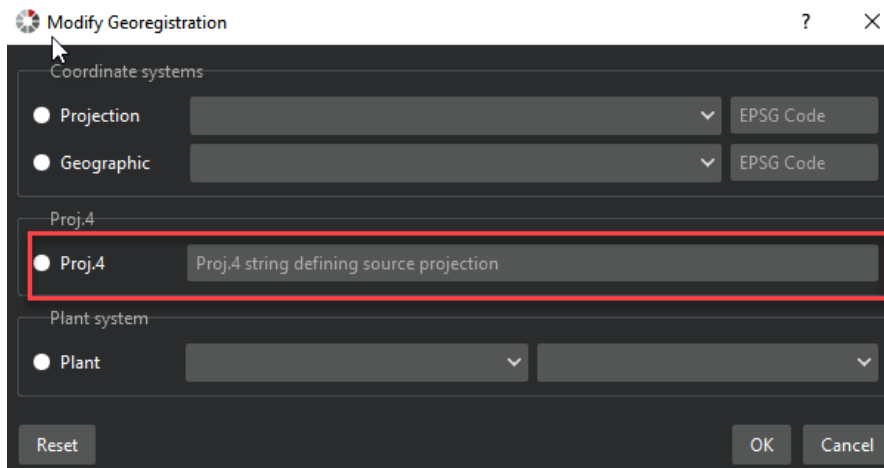


You can define the **Plant system** in the Modify Georegistration dialog by specifying the horizontal and vertical units of measure.

**Note:** If the vertical unit of measure is not specified, it defaults to the horizontal unit of measure.

### 2.2.4    Number of Points in the File

The metadata interface displays the number of points reported in the header block of the source data. It cross-references this with an estimated calculation of the number of points in the file and any difference is reported.

| Type | Value |
|---|---|
| File Cre...ion Date | Unable to retrieve file creation date |
| Total Points | 20826 |
| Extent Min | 250004.36, 2762941.87, 17.64 |
| Extent Max | 250698.44, 2763581.92, 19.99 |

It should be noted that with compressed LAZ files the estimating of the number of points can be imprecise and therefore may be different. The number of points in the file is needed to allow random access to the data for deriving data such as the classification of return points.

### 2.2.5    Classification of Data

LAS data points not only have a position, intensity and RGB value, they also have a classification value. When a single LAS file is selected in the interface and the metadata for the file is displayed, at the end of the metadata interface is a summary of the classification of the points. This table is derived by taking a random sample of points from within the file and reading classification values. There is a small overhead in obtaining this information so the interface may take a second or two to update.

| Classification | sampled 500 points |
|---|---|
| Unclassified | 19% |
| Ground | 43% |
| Transmission Tower | 10% |
| Wire Structure Connector | 27% |

### 2.2.6    Error Messages

In the event where there is an issue reading the LAS data, this will be reported in the metadata interface.

| Type | Value |
|---|---|
| File Name | 000057 |
| Message | Invalid LAS format data, contact data provider. |

## 2.3 Conversion Options

Project conversion options can be set in **File** > **Options** > **Gateway** as shown below:

These are global preferences and will be applied to all scans added to the project.
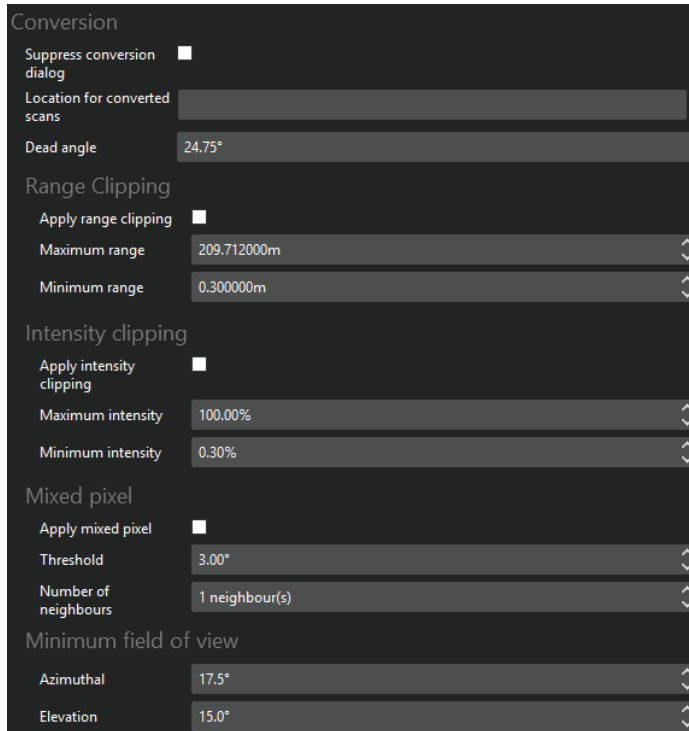


**Range Clipping**

To aid the modelling and viewing process, data which is considered too near or too far away to be of interest can be clipped using the near and far range clipping. Points that have been clipped in this way are not displayed at all in the 3D window. The near and far clipping values can be adjusted directly by double-clicking on the desired option and typing a new value into the appropriate text fields or clicking on the up and down arrows.

The minimum and maximum range values will be set to the optimum values relative to the scanner type.

### Intensity Clipping

To aid the modelling and viewing process, it is possible to clip intensity data which is considered too bright or too dull to be of interest. Points that have been clipped in this way are not displayed at all in the 3D window. The near and far clipping values can be adjusted directly by double-clicking on the desired option and typing a new value into the appropriate text fields or clicking on the up and down arrows.

The minimum and maximum intensity values will be set to the optimum values relative to the scanner type.

### Mask Pixels

This function is designed to significantly reduce the splatter, or spray effect which arises when the laser scanner's beam switches from one object to another. It is able to locate lone pixels or pixels which have too few neighbours.

All non-boundary pixels have eight surrounding neighbours and so, in normal circumstances, a pixel would expect to find its nearest neighbours at similar ranges.

The options are as follows:

- **Apply Mixed Pixel** - Pixels that are at different ranges are flagged as being mixed pixels and are then masked out of the image. Enable this field to apply mixed pixel.

- **Number of Neighbours** (ranges from 1-8) - This value sets a threshold for required neighbouring points. If the threshold value is not reached, a pixel is deemed noisy and masked out.

  The recommended value is 2.

- **Threshold** (degrees) - As an image is scanned by the algorithm, each pixel in turn becomes the centre pixel with eight neighbours. Eight lines are then formed from the centre pixel to its neighbours.

  The Rejection Angle is the angle formed between the view line (line between the centre pixel and the origin) and each of the eight pixel lines.

  The recommended value is 5°.

Data masked out by this function will not be visible in 3D Modelling Windows, but will be coloured green in 2D Image Windows. The effect of the mask mixed pixels function is entirely reversible by modifying the conversion options and reconverting the scans.

In common with all these data points functions, the data is never actually deleted or modified, but is masked out and so easily restored.

### Minimum Field of View

The minimum azimuthal and elevation required for a scan to be processed. Scans not fitting this criteria will not be processed. This is often useful for bundled ptx scans which contain very small partials that are not of much value in isolation.

### Dead Angle

This enables the user to change the dead region cut-off zone in the base of the scan. The default settings remove the points in the area directly underneath the scanner, where the scanner may see its own tripod. This may be adjusted if a slightly higher viewing angle is required. To change, double-click the desired option and type the new value into the appropriate text fields or click the up and down arrows.

### Individual Scan Settings

On review of the converted scans, several individual scans may require different conversion settings, for example a longer range setting.

To do this:

1. In the **Registration** panel, create a new group by right-clicking the project and selecting the **New** > **Register** Group.
2. Rename the group by right-clicking on the group and selecting **Rename**.
3. Type in the desired name and press **Enter**.

The group conversion options can be edited at the bottom of the properties window as shown below. Scans can be added to a group by clicking and dragging the scans onto the group node.
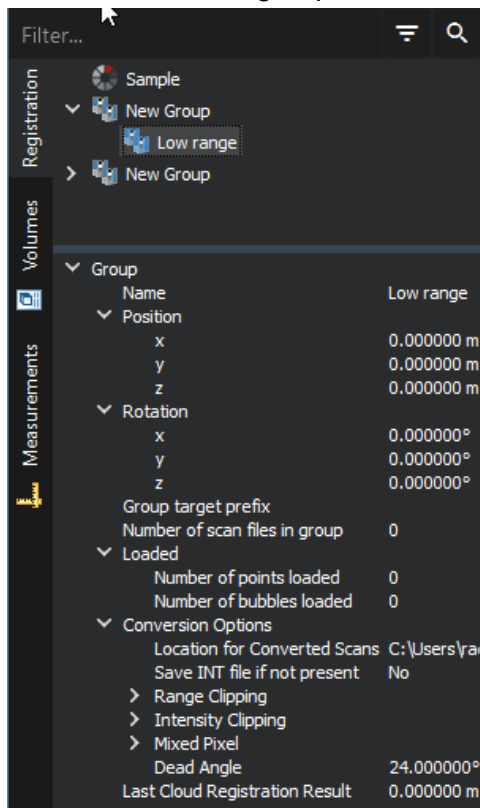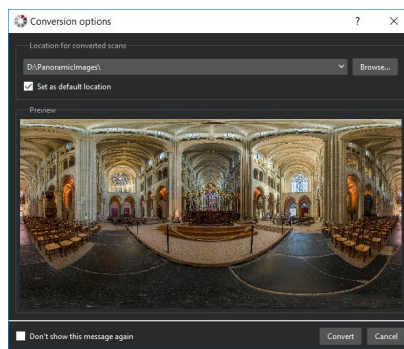
## 2.4    Importing Panoramic Photos

AVEVA LFM Server Gateway Mode supports the import of panoramic photos in .jpg, .png or iSTAR (.nctri) formats.

To import panoramic photos:

1.   In the Registration panel, right-click the project and select **Import to this project**. This opens a browser.

2.   Select the panoramic photos to be added and click **Open**.

3.   Alternatively, select the panoramic photos to be added in a Windows Explorer window and drag and drop them on to the project node. The window shown below appears:



4.   Click **Browse** and select the location for the output files, then click **Select Folder**. A preview of the panoramic photo will be shown in the lower part of the dialog.

5.   Click **Convert** to begin the import process.

After the import process has completed the panoramic photo will be available in the **Registration** panel. It is also represented in the 3D view by a 3D shape. The .jpg and .png files are represented by a sphere, .nctri files are represented by an iSTAR camera shaped object.

To view the panoramic photo follow the steps below:

1.  Right-click the name and select **Show Panoramic Image**.

2.  Alternatively, you can drag and drop the panoramic photo node from the **Registration** panel into the 3D view to load the panoramic photo **OR** You can right-click the panoramic photo representation in the 3D view and select **Show Panoramic Image**. The panoramic photo is displayed as shown below:

3.  Click and drag to move the view around and use the mouse wheel to zoom in and out, just like a BubbleView. As there is no 3D scan data linked to a panoramic photo, functionality is limited to viewing only.

To close the panoramic image, hover over the top-right corner of the 3D window and click the **Panoramic Image** icon. Then click **Close Panoramic Image**.



Panoramic photos are positioned at 0,0,0 by default. However, they can be repositioned by either entering coordinates or by visually positioning them in the 3D window.

**Entering Coordinates**

To change the position of a panoramic photo by entering coordinates, follow the steps below:

1. In the **Registration** panel, select the panoramic photo to be positioned.

   At the bottom of the **Registration** panel, you will see the Attributes window which displays information about the panoramic photo, including the position.

To edit the position, follow the steps below:

1. Click to select the relevant x/y/z field, and then double-click to make the field editable.

2. Enter the desired coordinate and press **Enter**.

3. Repeat this for the other positional fields.

**Visually Positioning**

To change the position of a panoramic photo by visually positioning it, follow the steps below:

1. In the **Registration** panel, right-click the panoramic photo and select **Manipulate**.

2. In the 3D window the panoramic photo 3D representation is shown with a red/green/blue coordinate frame around it.
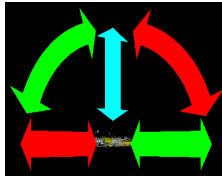


3. Click and drag the relevant arrows to move the panoramic photo to the appropriate position.

4. Right-click one of the arrows to accept the new position or press **Esc** to cancel the manipulation and return the item to its original position.

Any panoramic photos present in the project at the point of dataset (.lfd) generation is carried through to the AVEVA LFM Server dataset for viewing by engineering users.

# 3 Registration Using a Full Survey

This section provides details on registering scans using a full survey.

## 3.1 Adding the Survey

To add the survey, follow the steps below:

1. In the **Registration** panel, right-click the project node and select **Import to this project**. This brings up a browser.

2. Select the survey file to be added and click **Open**. The supported survey formats are .crd and .k.

These are effectively composite files, comprising consolidated data from all field survey stations. Users may adapt unsupported formats to comply with the standard AVEVA LFM files, please review the examples listed below:

**Sample format of a .crd (coordinate) file.**

| | | | |
|---|---|---|---|
| T001 | 0.000 | 0.000 | 0.000 |
| T002 | 13.000 | 11.000 | 16.000 |
| T003 | 11.250 | 10.019 | 32.233 |
| T004 | 19.845 | 96.100 | 34.892 |
| T005 | 67.228 | 56.872 | 34.766 |

Target name, X, Y & Z stored in metres.

**Note:** File can be space or tab delimited

**Sample format of a K (Kramer) file.**

| | | | | |
|---|---|---|---|---|
| T001 | 7 | 0.000 | 0.000 | 0.000 |
| T002 | 7 | 13.000 | 11.000 | 16.000 |
| T003 | 7 | 11.250 | 10.019 | 32.233 |
| T004 | 7 | 19.845 | 96.100 | 34.892 |
| T005 | 7 | 67.228 | 56.872 | 34.766 |

**Note:** There should be six blank lines at the top of the file. The first figures should be the target identifier, the second column should contain a figure seven (AVEVA LFM will ignore), with the remaining X – Y – Z readings. (Easting, Northing & Elevation) All numbers recorded are interpreted as metres. This is to copy the format of the Kramer survey adjustment package.
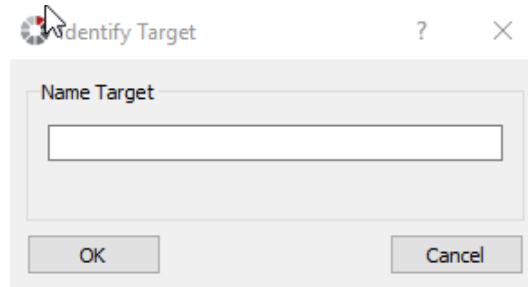
## 3.2 Identifying Targets

To identify targets, follow the steps below:

1. After the survey has been added, right-click the scan to be registered and select **Show BubbleView** OR alternatively drag and drop the scan node into the 3D window. The BubbleView loads for the selected scan and the Tools toolbar becomes available at the top of the interface.

2. Load the 3D points belonging to a scan by right-clicking on the scan and selecting **Load Points**.

3. Navigate round the BubbleView to the first target to be picked. Click the **Pick Targets** button from the Tools menu and select the target centre with a left mouse click. This brings up a small magnified target identification area where the target centre can be picked by a left mouse click.



4. Alternatively, targets can also be picked in the 3D window. This is useful for registering mobile scan data such as .pts or .dp, which will not produce a BubbleView.

5.  After picking the target centre, the Identify Target window appears. Type in the name of the target and click **OK**.



**Note:** The target name should exactly match the survey, for example if the target in the survey is referred to as *rr127, the name entered must be *rr127. Note also that this is case sensitive.

The user may apply a group target prefix if all targets have the same prefix. To do this, follow the steps below:

1.  In the attributes window, select the appropriate group and fill in the **Group target prefix** option as shown below. This automatically enters the specified prefix in the Identify Target window when selecting targets. Identified targets appear as yellow crosses in the BubbleView and as black target icons under the scan node in the Registration tab. If the target number entered cannot be found in the survey, a red exclamation mark is shown over the black target icon in the Registration tab.
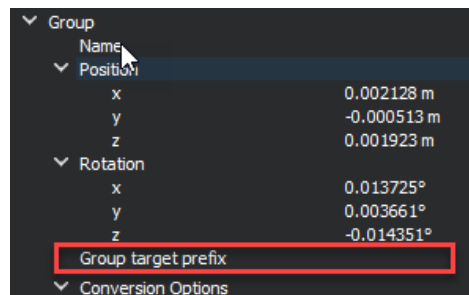


2.  Repeat this process for other targets visible in the scan.

**Target Predication**

When two targets have been identified, other targets in the scan will begin to appear through the target prediction system. These appear as green crosses in the BubbleView and green target icons under the scan node in the Registration tab.

Select a predicted target by double-clicking on it under the scan node in the Registration tab. This will centre the BubbleView and target identification zoom window on the predicted target.

**Note:** Targets are sorted by ascending range so it is often best to start with the target at the top of the list.

There are four options at this stage:

- Click the centre of the target to change the position and name of the predicted target and move on to the next prediction.

- Right-click the centre of the target to change only the position. This accepts the predicted target name and moves on to the next prediction.

- Click the ✅ button in the target identification zoom window. This accepts both the position and the name of the predicted target and moves on to the next prediction. The "Y" button on the keyboard will also perform the same function.

- Click the ❌ button in the target identification zoom window. This does not accept the predicted target and move on to the next prediction. This is used when the target cannot actually be seen (for example, if it is on the other side of a wall or if it is too far away). The "N" button on the keyboard also performs the same function.

**Note:** If a picked target has a negative effect on the scan registration (such as by causing a traffic light to turn red) then the target zoom window remains on that target and will not proceed to the next prediction. This is an alert to the user that the accuracy of the registration has been compromised and the user should address the error before moving on.

## 3.3    Target Accuracy

After a target is registered, feedback on the accuracy is displayed at the side of the target in the Registration tab. This feedback takes the form of two traffic light icons. This is a rapid way of interpreting registration accuracy. The coloured icons enable the user to visually skim through the results, focusing quickly on the targets causing concern. These appear as amber or red in the components browser.

The diamond shape refers to the inter distance between the selected target and its neighbours within the scan. These inter distances are compared against the corresponding inter distances in the survey.

The circle shape refers to the distance between the picked target in the scan and the corresponding target position in the survey post registration. Generally, there should be more than 5 target correspondences in every scan to ensure accurate registration.



The traffic lights will be red, amber or green. The thresholds for these colours can be changed in the **File** > **Options** > **Gateway** tab.

Anything between 0 and the amber threshold will be green. Anything between the amber threshold and the red threshold will be amber. Anything above the red threshold will be red.

The recommended values are amber = 0.003m and red = 0.006m. If the threshold is altered during registration, an automatic update of target accuracy is carried out respective to the new settings.

As soon as two targets have been selected within a scan, provided a survey is attached to model, the system shows the accuracy of the target fitting. As this process is ongoing as targets are selected, poorly fitted targets will be highlighted instantly, allowing an immediate refit. This saves a great deal of time later on identifying rouge targets. Numerical error readings are provided in the Attributes window for confirmation.

**Improving the Accuracy of Poorly Fitting Targets**

The example shown below demonstrates poor accuracy on target 091:
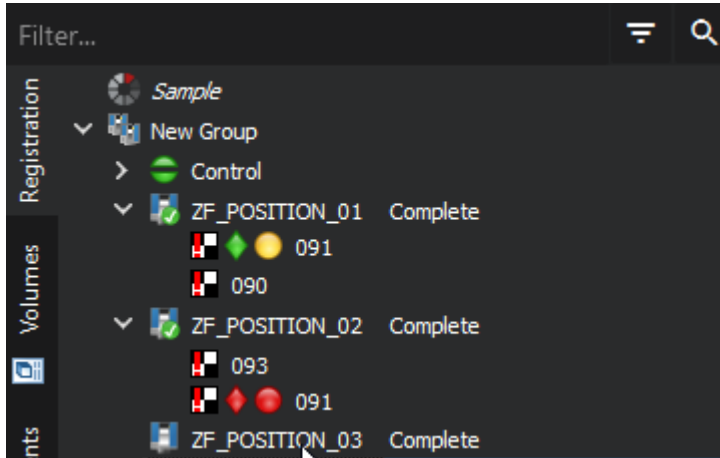


Inaccurately fitted targets such as this can be reviewed by right-clicking on the target in the Registration panel and selecting **Show Context**. This shows the graphical representation of the pick against the 3D point cloud.
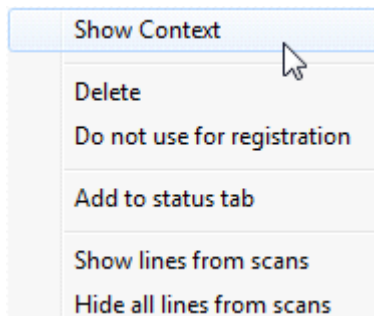


Targets can be re-picked by clicking on the centre of the target in the target identification window within the BubbleView, entering the target name and clicking **OK**. This will present a warning as shown below that the target has already been picked. Click **Yes** to accept or **No** to cancel.
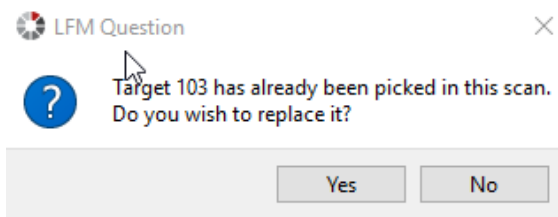


Targets can also be temporarily disregarded by right-clicking on the target in the Registration tab and selecting **Do not use for Registration**. Targets that have the **Do not use for Registration** feature applied are shown with a red strikethrough as shown below on target 130.

The image shown below demonstrates the scan registration after the **Do not use for Registration** feature has been applied to a target. The registration of the scan is now good. This feature can be removed if necessary by right-clicking again on the target and selecting **Use for Registration**.
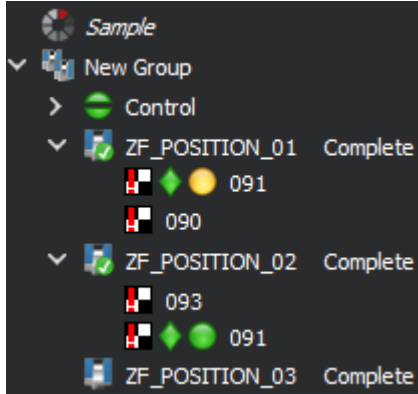


When the registration is complete you can then move on to the next scan. This should be repeated for all scans in the project.

**Note:** Target sizes can be changed in the **File** > **Options** > **Gateway** tab as shown below:
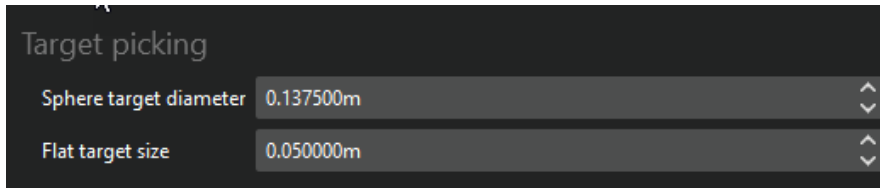


After the Registration is complete, it is good practice to update the scan headers. This stores the position, rotation and targets in the .zfc file itself rather than just the project file. This means that registered scans can be added to another project still in the correct position. This is also useful for service providers delivering to users using AVEVA LFM Modeller or AVEVA Laser Modeller.

**Note:** The .zfc files generated using *AVEVA LFM Server 4.4.2* version support an extended range and hence cannot be read by earlier versions of *AVEVA LFM Server* and AVEVA Laser Modeller/AVEVA LFM Modeller.

To update the scan headers, right-click the group node and select **Scan Headers** > **Update ZFC Headers**.

To update the ZFS scan headers, right-click the group node and select **Scan Headers** > **Update ZFS Headers**. This preserves the positions of the aligned scans when used in a different project. You can then use the ZFS scan files to produce different outputs, such as ReCap, Cloudworx, TruView and so on, without having to re-register the scans in another registration toolset.

# 4 Registration Using a Partial/No Survey with Targets

If site access is limited there may only be a partial survey or no survey at all. If targets have been placed in the scanned scene, these can be registered using a process called Bundle Adjustment. If a partial survey is used, the scans will be registered to the site coordinates as specified in the partial survey. If no survey is used, the scans will be registered locally.

Bundle adjustment is an iterative process which calculates the mean position of a target from each target pick over multiple scans.

Before starting registration using Bundle Adjustment, please ensure the **Perform Bundle Adjust** option in the **File** > **Options** > **Gateway** tab is enabled.
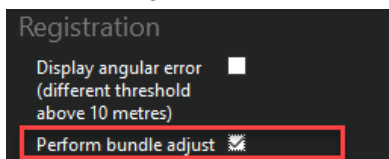


## 4.1 Adding the Survey

If a partial survey is available, add the survey by following the steps below:

1. In the **Registration** panel, right-click the project node and select **Import to this group**. This brings up a browser.

2. Select the survey file to be added and click **Open**. Supported survey formats are .crd and .k.

These are effectively composite files, comprising consolidated data from all field survey stations.

Users may adapt unsupported formats to comply with the standard AVEVA LFM files, please review the examples listed below.

**Sample format of a .crd (coordinate) file.**

| | | | |
|---|---|---|---|
| T001 | 0.000 | 0.000 | 0.000 |
| T002 | 13.000 | 11.000 | 16.000 |
| T003 | 11.250 | 10.019 | 32.233 |
| T004 | 19.845 | 96.100 | 34.892 |
| T005 | 67.228 | 56.872 | 34.766 |

Target name, X, Y & Z stored in metres.

**Note:** File can be space or tab delimited.

**Sample format of a K (Kramer) file.**

| | | | | |
|---|---|---|---|---|
| T001 | 7 | 0.000 | 0.000 | 0.000 |
| T002 | 7 | 13.000 | 11.000 | 16.000 |
| T003 | 7 | 11.250 | 10.019 | 32.233 |
| T004 | 7 | 19.845 | 96.100 | 34.892 |
| T005 | 7 | 67.228 | 56.872 | 34.766 |

**Note:** There should be six blank lines at the top of the file. The first figures should be the target identifier, the second column should contain a figure seven (*AVEVA LFM* will ignore), with the remaining X – Y – Z readings. (Easting, Northing & Elevation) All numbers recorded will be interpreted as metres. This is to copy the format of the Kramer survey adjustment package.

## 4.2    Identifying Targets

To identify targets, follow the steps below:

1.  After the survey has been added, right-click the scan to be registered and select **Show BubbleView** OR alternatively drag and drop the scan node into the 3D window. The BubbleView will load for the selected scan and the Tools toolbar will become available at the top of the interface.

2.  Load the 3D points belonging to a scan by right-clicking on the scan and selecting **Load Points**.

3. Navigate round the BubbleView to the first target to be picked. Click the **Pick Targets** button from the Tools menu and select the target centre with a left mouse click. This brings up a small magnified target identification area where the target centre can be picked by a left mouse click.



4. Alternatively, targets can also be picked in the 3D window. This is useful for registering mobile scan data (such as .pts or .dp) which will not produce a BubbleView.

5. After picking the target centre the Identify Target window is displayed. Type in the name of the target and click **OK**. Identified targets appear as yellow crosses in the BubbleView and as black target icons under the scan node in the Registration tab.
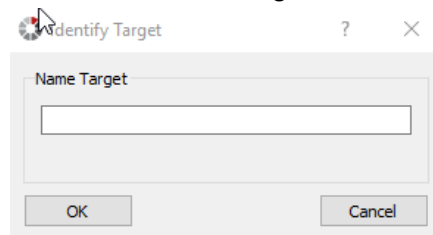


6. Repeat this process for other targets visible in the scan.

To register the scans using the currently identified targets, right-click the group node and select **Register All**.

**Note:** This function only applies to the parent group, it does not apply to any child groups.

**Target Prediction**

Any targets identified that do not have a corresponding survey point will be added to the bundle node. The bundle acts as an artificial survey which is made up by the targets picked in previous scans. When the bundle is built up enough to be used, AVEVA LFM's target prediction system will become available as detailed below.

After two targets have been identified other targets in the scan will begin to appear through the target prediction system. These will appear as green crosses in the BubbleView window and green target icons under the scan node in the Registration tab.

Select a predicted target by double-clicking on it under the scan node in the Registration tab. This will centre the BubbleView and target identification zoom window on the predicted target.

**Note:** Targets are sorted by ascending range so it is often best to start with the target at the top of the list.

There are four options at this stage:

- Left-click the centre of the target to change the position and name of the predicted target and move on to the next prediction.

- Right-click the centre of the target to change only the position. This accepts the predicted target name and moves on to the next prediction.

- Click the ✅ button in the target identification zoom window. This accepts both the position and the name of the predicted target and moves on to the next prediction. The "Y" button on the keyboard also performs the same function.

- Click the ❌ button in the target identification zoom window. This will not accept the predicted target and move on to the next prediction. This is used when the target cannot actually be seen (for example, if it is on the other side of a wall or if it is too far away). The **N** button on the keyboard will also perform the same function.

**Note:** If a picked target has a negative effect on the scan registration (such as by causing one or more traffic lights to turn red) then the target zoom window will remain on that target and will not proceed to the next prediction. This is an alert to the user that the accuracy of the scan has been compromised and the user should investigate further before moving on.

If scans are registered locally to each other, it is possible that the "master" scan (which the others are registered to) will be classed as unregistered. As unregistered scans are not included in the AVEVA LFM Server dataset generation, you may wish to class the master scan as registered. To do so, right-click the master scan and select **Force to Registered**.

## 4.3    Target Accuracy

After a target is registered, feedback on the accuracy will be displayed at the side of the target in the Registration tab. This feedback takes the form of two traffic light icons. This is a rapid way of interpreting registration accuracy. The coloured icons enable the user to visually skim through the results, focusing quickly on the targets causing concern. These will appear as amber or red in the components browser.

The diamond shape refers to the inter distance between the selected target and its neighbours within the scan. These inter distances are compared against the corresponding inter distances in the survey or bundle as appropriate.

The circle shape refers to the distance between the picked target in the scan and the corresponding target position in the survey or bundle, post registration. Generally, there should be more than 5 target correspondences in every scan to ensure accurate registration.

The traffic lights will be red, amber or green. The thresholds for these colours can be changed in the **File** > **Options** > **Gateway** tab.
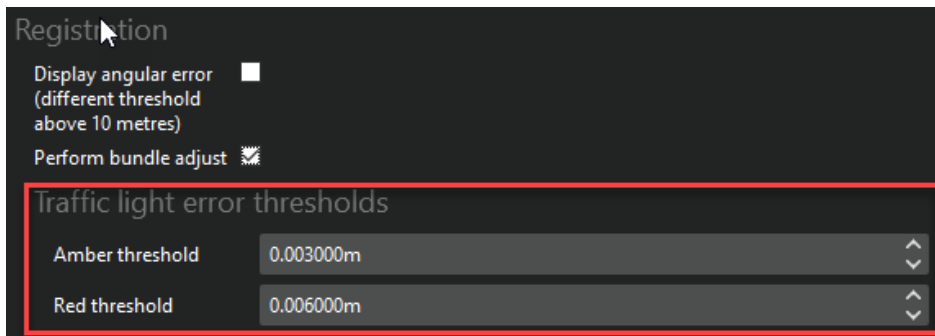


Anything between 0 and the amber threshold will be green. Anything between the amber threshold and the red threshold will be amber. Anything above the red threshold will be red.

The recommended values are amber = 0.003m and red = 0.006m.

If the threshold is altered during registration, an automatic update of target accuracy is carried out respective to the new settings.

**Improving the Accuracy of Poorly Fitting Targets**

The example shown below demonstrates poor accuracy on target 091.
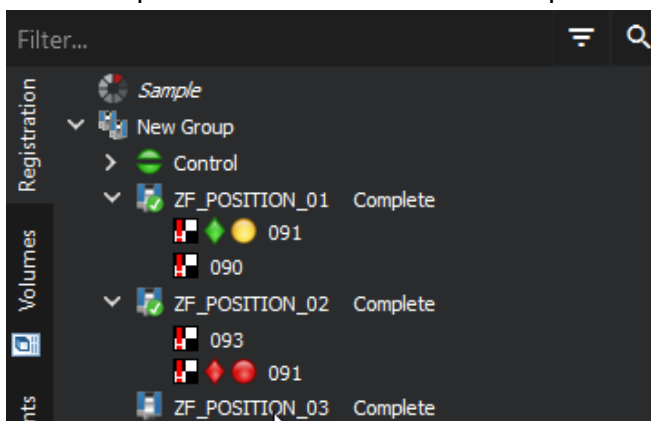
Inaccurately fitted targets such as this can be reviewed by right-clicking the target in the **Registration** tab and selecting **Show Context**. This shows the graphical representation of the pick against the 3D point cloud.
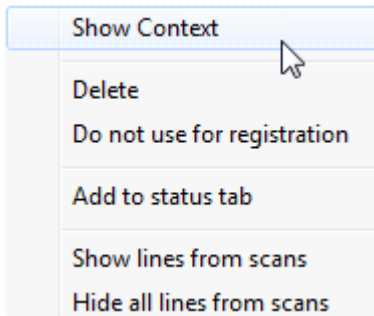


Targets can be re-picked by clicking the centre of the target in the target identification window within the BubbleView, entering the target name and clicking **OK**. This presents a warning as shown below that the target has already been picked. Click **Yes** to accept or **No** to cancel.
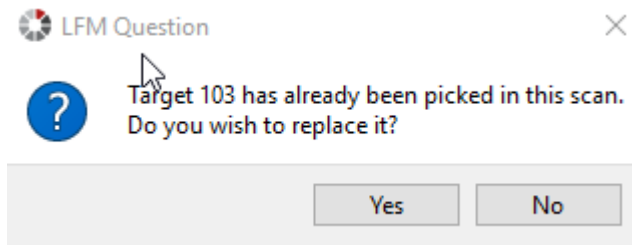


Targets can also be temporarily disregarded by right-clicking the target in the **Registration** tab and selecting **Do not use for Registration**. Targets that have the **Do not use for Registration** feature applied are shown with a red strikethrough as shown below:
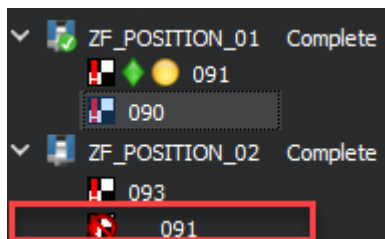


The image shown left demonstrates the scan registration after the **Do not use for Registration** feature has been applied to target 130. The registration of the scan is now good. This feature can be removed if necessary by right-clicking again on the target and selecting **Use for Registration**.

After the registration is complete right-click the scan and select **Register All**. You can then move on to the next scan. This should be repeated for all scans in the project.

**Note:** Target sizes can be changed in the **File** > **Options** > **Gateway** tab as shown below:

Target picking

| | |
|---|---|
| Sphere target diameter | 0.137500m |
| Flat target size | 0.050000m |

After the Registration is complete it is good practice to update the scan headers. This stores the position, rotation and targets in the .zfc file itself rather than just the project file. This means that registered scans can be added to another project still in the correct position. This is also useful for providers delivering to users using AVEVA LFM Modeller or AVEVA Laser Modeller.

To update the scan headers right-click the group node and select **Scan Headers** > **Update ZFC Headers**.

To update the ZFS scan headers, right-click the group node and select **Scan Headers** > **Update ZFS Headers**. This preserves the positions of the aligned scans when used in a different project. You can then use the ZFS scan files to produce different outputs, such as ReCap, Cloudworx, TruView and so on, without having to re-register the scans in another registration toolset.

# 5 Registration Using No Survey without Targets (Inter-Cloud Registration)

If site access is limited, there may be no survey and no targets placed throughout the scanned scene. In these circumstances, scans can still be registered by identifying common points between each of the scan locations. If used in conjunction with scans registered to a survey, these scans can be registered to site coordinates. If there are no scans that have been registered to a survey, the scans will be registered locally.

Scans that will be registered through Inter-cloud registration should be placed in their own subgroup. To do this:

1. Right-click the project or parent group and select **New** > **Register Group**.

2. Then click and drag the scans into the new group.

## 5.1 Identifying Common Points

To identify common points, follow the steps below:

1. Right-click the scan to be registered and select **Show BubbleView** OR alternatively drag and drop the scan node into the 3D window. The BubbleView will load for the selected scan and the Tools toolbar will become available at the top of the interface. Anything on a flat surface can be used as a target as long as it can be seen in both scans being registered together. Corners of signs or small marks on walls traditionally make good targets.

2. Load the 3D points belonging to a scan by right-clicking on the scan and selecting **Load Points**.

3. Navigate round the BubbleView to the first point to be picked.

4. Click the **Pick Targets** button from the BubbleView toolbar and select the point with a left mouse click. This brings up a small magnified target identification area.



5. Alternatively, targets can also be picked in the 3D window. This is useful for registering mobile scan data (such as .pts or .dp) which will not produce a BubbleView.

6. After picking the target, the Identify Target window appears. Type in the name of the target (example, T1) and click **OK**. Identified targets appear as yellow crosses in the BubbleView and as black target icons under the scan node in the Registration tab.
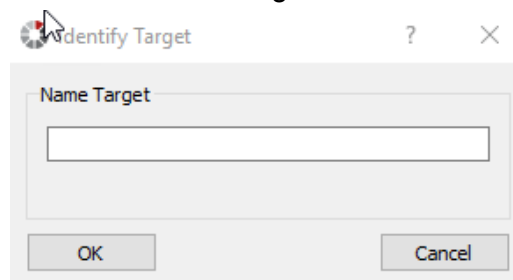


7. Repeat this process for other targets in the scan and also the same targets in the other scans to be registered.

8. After the targets have been identified in both scans, right-click the group node and select **Register All**. Depending on the quality and accuracy of the picked targets, this will place the scans in roughly the correct position.
   **Note:** This function only applies to the parent group, it does not apply to any child groups.

## 5.2     Visual Scan Manipulation

The visual scan manipulation can be used as an alternative way to register scans when there is no survey or targets.

1.  The user may drag the scans close to the correct position through scan manipulation. To do this, right-click the scan to be moved and select **Manipulate**. This brings up an rbg modification frame positioned around the scan centre as shown below:
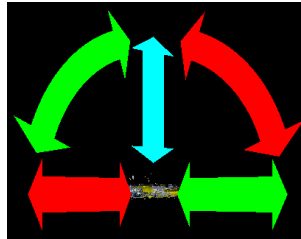


2.  Hover the mouse cursor over the axis you wish to move or rotate the scan around.

3.  Click and drag the scan to the desired position.

To escape this function and return the scan to its original position, press **Esc**. To accept the new scan position, press **Enter**.

## 5.3     Completing the Registration

After the scans are in roughly the correct position, *AVEVA LFM* can further improve the registration using its in-built Inter-cloud registration function.

To do this:

1.  Right-click the group containing the scans to be registered and select **Cloud All**. This brings up the Inter-cloud registration options window as shown below:
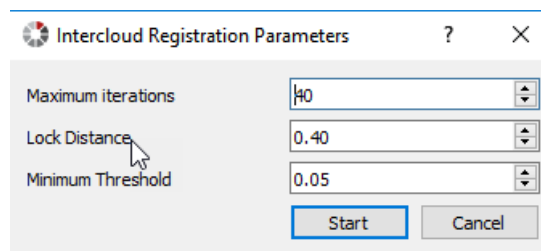


**Note:** All the scans to be registered in this way must be loaded in both the 3D and BubbleView first.

2. Set the following options:

- **Maximum iterations**: The number of times the Inter-cloud process will run before completing unless it reaches the minimum threshold option as described below. Increasing this value will lead to better registration but will also take longer for the function to complete.

- **Lock Distance**: The distance AVEVA LFM looks for neighbouring points within when calculating the registration. The value entered here is the starting value. This value will decrease as the processing progresses.

- **Minimum Threshold**: The error per point used that the Inter-cloud process aims for. When the value is reached, the process will complete unless the process reaches the maximum iterations value.

3. Press **OK** to start the Inter-cloud registration procedure. This may take some time depending on the number of scans to be registered and the initial placement of the scans.

During the Inter-cloud process, if the group node is selected in the **Registration** tab, the attributes window will display information about the process as shown below. This can be used to gauge how far along the process is.
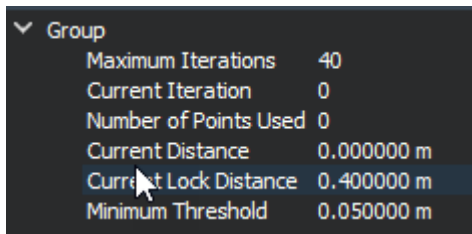
After the Inter-cloud process is complete, the attributes window will return to displaying information about the group. There will be an additional entry at the bottom of the attributes window called **Last Cloud Registration Result**.



After the Registration is complete, it is good practice to update the scan headers. This stores the position, rotation and targets in the .zfc file itself rather than just the project file. This means that registered scans can be added to another project still in the correct position. This is also useful for providers delivering to users using AVEVA LFM Modeller or AVEVA Laser Modeller.

To update the scan headers, right-click the group node and select **Scan Headers** > **Update ZFC Headers**.

To update the ZFS scan headers, right-click the group node and select **Scan Headers** > **Update ZFS Headers**. This preserves the positions of the aligned scans when used in a different project. You can then use the ZFS scan files to produce different outputs (such as ReCap, Cloudworx, TruView and so on), without having to re-register the scans in another registration toolset.

# 6 QA Reporting

This section covers information on checking the registration quality for QA checks.

## 6.1 Registration Status Tab

The **Registration Status** tab enables rapid interpretation of registration quality for quick and easy QA checks. Registration can be checked at both a scan and target level.

To add scans or targets to the Registration Status tab, follow the steps below:

1. Select the desired scans/targets in the Registration Management Panel.

2. After the desired scans/targets have been selected, right-click and select **Add to registration status tab** OR drag and drop the scans/targets on to the Registration Status tab.

3. The selected scans are displayed in the **Registration Status** window as shown below:



Each scan will have an overall traffic light to indicate any problem targets.

- If a scan has one or more red traffic lights, the overall traffic light will be red.

- If a scan has no red traffic lights but one or more amber traffic lights, the overall traffic light will be amber.

- If the scan has no red or amber traffic lights the overall traffic light will be green.

To see the targets identified in each scan, click the arrow on the left of the desired scan name. This shows details of all the targets: their position, the error of the overall target from the survey and the correspondence (bundle or survey).

To close the Registration Status window, hover over the top-right corner of the workspace window and click the **Registration Status List** icon, then click **Close Registration Status List**.



To see the details of each individual pick for a target, click the arrow on the left of the desired target. This shows details of all the individual picks that contribute to that target: the scan name, the position, the error of the individual pick from the survey and the error vectors of the individual pick from the survey.

If an individual pick is found to be bad (usually indicated by red traffic lights) the user can do the following:

1.  Right-click on that pick and select **Do Not Use For Registration**. This removes that pick from the calculation of the target and scan and re-registers the scan accordingly.

2.  After a pick has been confirmed as not being required, the user can right-click that target and select **Delete**.

3.  To further refine the information available, the user can right-click anywhere in the **Registration Status** window and apply one of the following filter options:

    *   Nothing

    *   Red and amber traffic lights

    *   Red traffic lights

The following table describes the different fields for a given target:

| Column Header | Purpose |
| --- | --- |
| Name | Name/identifier of the object plus an indication of quality (traffic lights) |
| Position | The x, y, z position of the object |
| Error | The distance between the surveyed point and the average of all related target picks |
| Error Vector | The x, y, z error |
| Correspondence | An indication to show if the target relates to the Survey or the Bundle |

**Exporting the Registration Information**

The registration information can be exported to a .csv file which can become the basis of a QA report for delivery to the client.

To do this, perform the following steps:

1.  Right-click anywhere in the **Registration Status** window and select **Export Report**.

2.  Select the appropriate destination, name the file and click **Save**.

## 6.2 Network View

The Network View enables the user to see a visual representation of the spread, location and quality of the scans and targets.
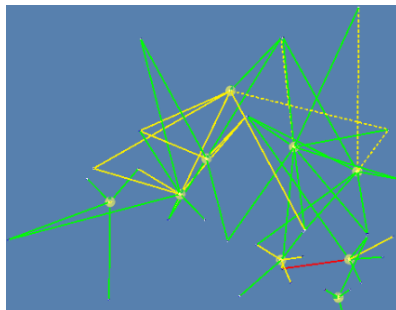


The best way to visualise this is to switch to the ortho view. To do this, hover over the top-right corner of the workspace window and click the **Switch to 3D perspective/3D orthographic** icon.

This splits the screen into a side-on and top-down view. The user may alter the proportions of this view by clicking and dragging (left/right) the dividing line as shown below:



The user may turn off the 3D points by clicking the **Points** button in the Visualisation menu.

Any scan/group/target that is loaded will have its network lines shown in the 3D. Scans that have been marked as **Do not use for Registration** will be shown as dotted lines. The colour of the lines will match the colour of the traffic lights for that target.

To keep the network lines for a particular scan on, right-click the scan in the **Registration** tab and select **Show lines from targets** as shown below:
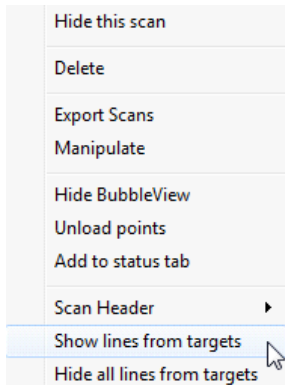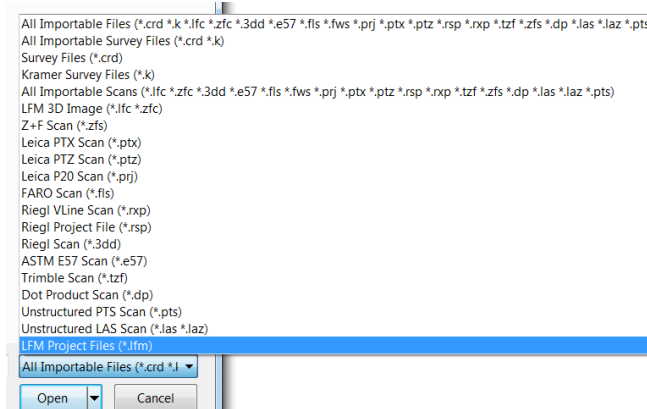


This keeps the network lines ON even if the scan is not selected in the Registration tab.

To hide the lines again, right-click the scan and select **Hide lines from targets**.

## 6.3 Merging Projects

It is sometimes desirable to split the registration of a large project across multiple users. Each user should have their own project file containing their scans to be registered. After each user has registered their own sub-project, a new master project should be created.

1. The sub projects can then be imported to the master project by right-clicking the project node in the master project and selecting **Import to this Project**.

2. In the browser that appears, change the file type filter to **LFM Project Files (*.lfm)**.

3. Navigate to and select the first sub-project file in the file browser and click **Open**. Repeat for all other sub-project files.

# AVEVA