

Instrument Manual

Interface to Leica iCon Construction Instruments
and Machine Control

LSSTM

Leica
Geosystems

scanlaser
MACHINE CONTROL 

icon
intelligent CONstruction

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Introduction

In our experience software options are often only used in their simplest forms particularly when combined with data transfer. This document aims to uncover the more powerful aspects of the use of LSS combined with the Leica iCON and Machine Control.

This document assumes the use of LSS v10.00.10 or later and the information is based on default installation/configuration settings and shows the principles and intricacies of the system from any perspective or knowledge base.

We hope that this document meets all your expectations, but if you feel that it has fallen short in any way please let us know so that we may improve its structure and content.

Chapter 1

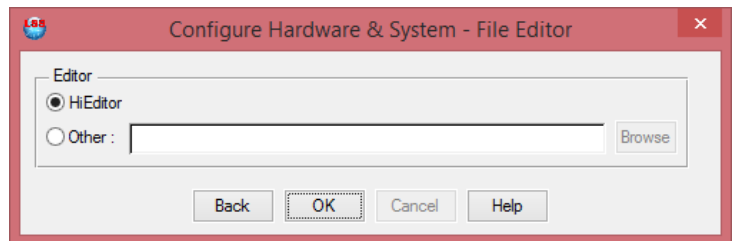
1.1 Configure / Hardware & System

This menu option controls the default LSS settings within the registry on this PC.

1.1 File Editor

Configures which application opens the browsed data file when the 'Edit' button is clicked.

Note: HiEditor is the recommended Editor for LSS and is installed with v10 and set as the default unless a previous version of LSS was already installed. In this case HiEditor will need to be selected here.



1.2 New Survey Parameters

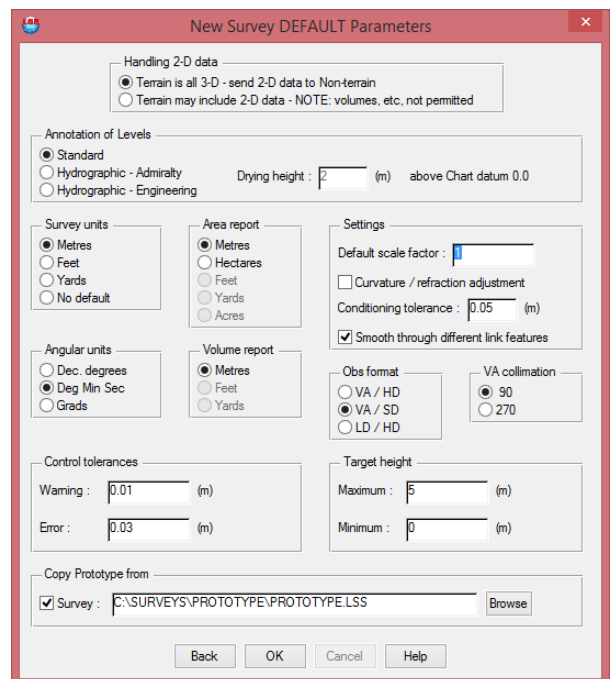
Holds the default settings for when a New survey is created;

Control tolerances - for Control Observation **warnings** and **errors**.

Target Height – Load issues **warnings** if a target height is outside this range.

Copy Prototype from – an LSS model that contains a feature legend template and display settings.

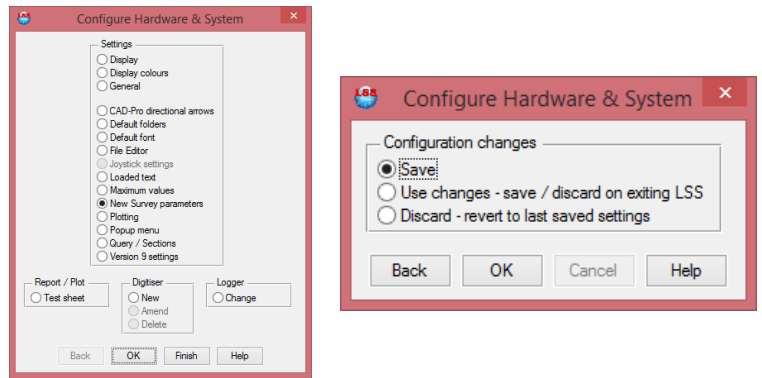
Note: the LSS model 'Prototype.LSS' is available in the '\\Testdata\\Prototype' folder (see above) and if copied to, say, "d:\<Survey Folder>\Prototype" it can be user defined.



1.3 Saving the Configuration Changes

If a change is made then on return to the main dialog a 'Finish' button will be offered.

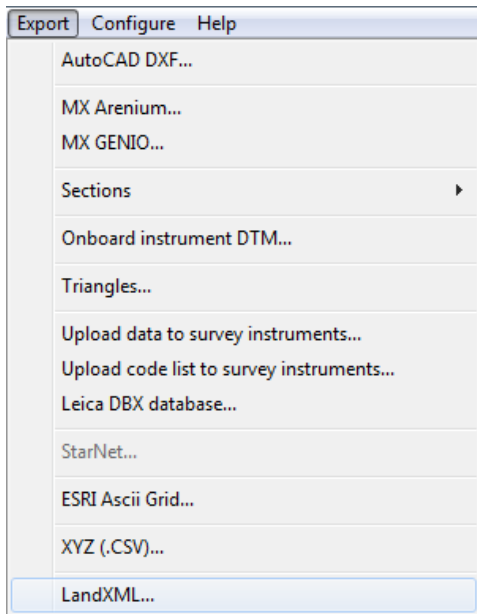
Clicking 'Finish' will offer the 'Configuration changes' options.



To save the changes select 'Save' and click 'OK' then LSS will permanently save these settings on this PC.

Chapter 2

2.1 Export from LSS Summary



The export process includes the following data types. The resultant files are placed in the Data folder on the UMC.

Triangles (DTM) – use Export / LandXML - via Reference
[Not Export Triangles as this creates a simple csv file].

Drawing (linework and text) – use Export / Autocad DXF

Linework includes design features to be displayed.

Text can be used to highlight hazards or the chainage along an alignment to the driver.

Alignments ('geometry' or 'straight lines' for the machine to 'follow') – use Export / LandXML

Alignments are used as a guide for the driver to follow.

Within LSS these are based on Section Position Files (SPFs), which may be converted from MX Genio or LandXML files, or created in the program.

Alignments may follow features or be simple straight lines.

2.2 Use of Export Options

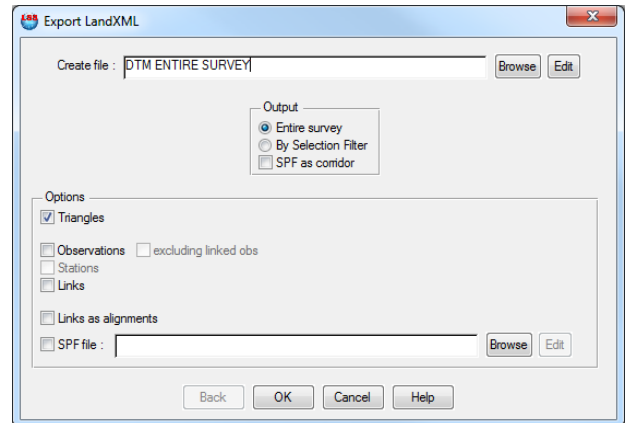
2.2.1 Export LandXML / Triangles (DTM)

Exports as LSS surface codes (void triangles are ignored)

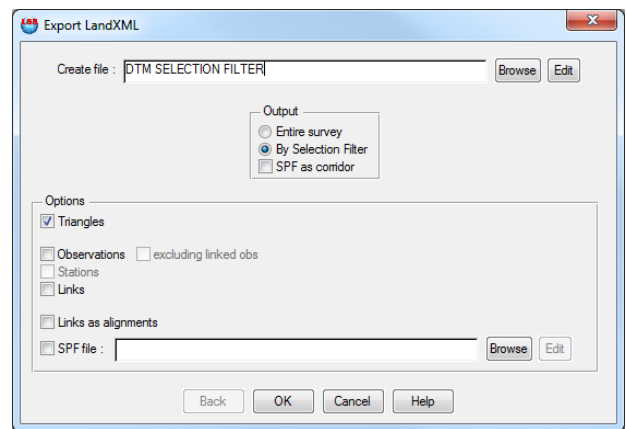
The 'Create file' input becomes the name of the TRM surface in the UMC.

Unset all the tick boxes apart from 'Triangles'
Use either

Entire Survey (as default) for the full set of triangles, or



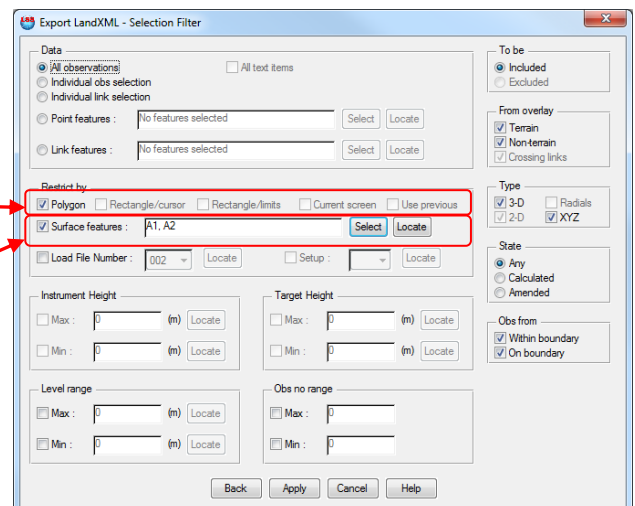
The Selection Filter can be used if only part of the model is required.



The triangles can be selected e.g. by the commands found in the :

'Restrict by' box e.g. 'Polygon'
click 'Apply'
click around the
area you wish to include
hit 'Esc'(Escape) key or
click 'Back' to close.

multi-select Surfaces
click 'Select'
highlight your selection
click 'OK'



To complete the Selection Filter process click 'Finish' (when a selection has been applied the 'Finish' button replaces 'Cancel').

2.2.2 Export AutoCAD DXF – Drawing (line work and text)

Configure DTM display

Observations Off

Point / Link Features All

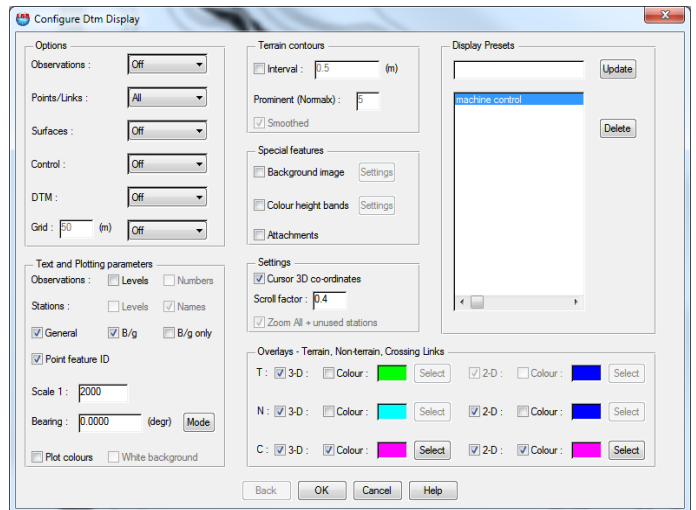
Grid Off

General Text

Set the scale so that the text can be clearly read when displayed in the cab

Set the contour interval if required – otherwise turn off

Any other settings as required



Overdisplay SPF - to also include the exported SPF reference line within the drawing if required.

Export to AutoCAD DXF

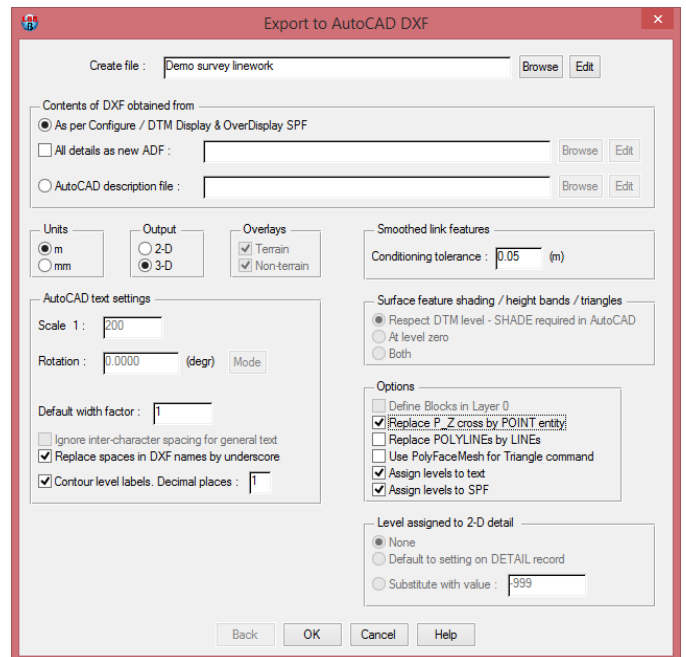
As per Configure / DTM Display

3-D

'Replace P_Z cross by POINT entity'

Enter a filename and click OK.

Note: The exported text will be in 3D where the text insertion point lies within the DTM.



2.2.3 Export LandXML / Alignments

Exported via 'SPF file' and/or 'Links as alignments'

Section Position File (SPF) - of which there are two types.

Note: Both types allow the exported string to have a user-controlled name (using the SPF file name). A Normal SPF (see below) can also use the section title to name the alignment(s) and control the chainage along with its direction.

Geometry SPF – these are created via a road or rail design geometry converted from a Genio or LandXML file where the filename is given the alignment name. This geometry set can then be viewed, analysed and exported using any of the Sections options inside LSS. This means that the chainage and position of any cross section will match that of the original design as well as the setting-out onboard the instrument. This type of SPF can only have one alignment per file and cannot be edited.

Normal SPF (straight lines only) the user can control the direction of each string independently via 'Configure / SPF create'. Using the 'Lines' method the cross sections are defined by the 'Section interval'. Individual cross sections can be positioned (along with the chainage and bearing if required) using the 'Points' methods. This type of SPF can contain multiple reference lines each with their own name.

The screenshot shows the 'Configure Section Position File Create' dialog box. Key settings are highlighted with red circles and callouts:

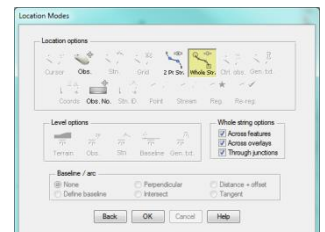
- 'Section position file'**: The 'Section position file' field is set to 'Example Alignment.SPF'.
- 'First section title'**: The 'First section title' field is set to 'Example alignment 1'.
- 'Offsets'**: The 'Offsets (-ve = left)' section shows 'Left' and 'Right' both set to 25 (m).
- 'Line(s) method'**: The 'Methods' section has 'Line(s)' selected.

Other visible settings include: Section interval: 10 (m), Start chainage: 0 (m), First section number: 1, Horizontal scale: 1:1000, Vertical scale: 1:1000, and 'Intermediate sections at' set to 'Multiple of the section interval'.

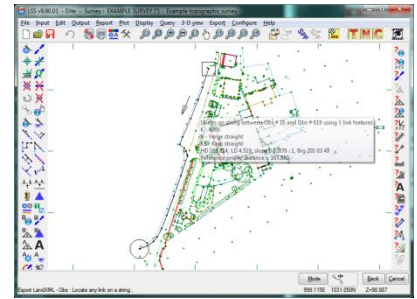
Click 'Next'

Click the Mode button and then Whole String (note the options for this setting)

Click OK



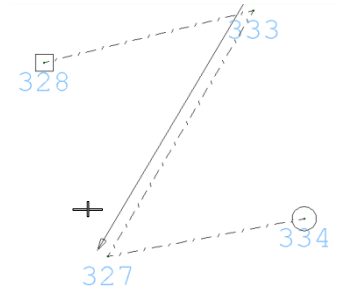
The Whole String Mode setting will now allow you to choose the string for your reference line



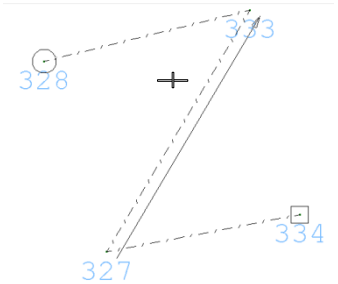
To change the direction of the string

Whilst hovering the cursor over a link LSS will show the complete string with a square at the start and a circle at the end.

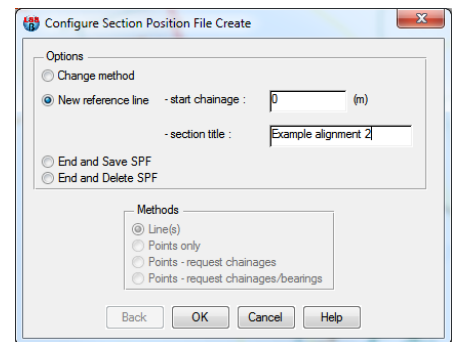
The link that is nearest to the cursor also shows the direction of the string with an arrow.



The direction of the string can be changed by moving the cursor along the link towards the observation that you require the direction to go.

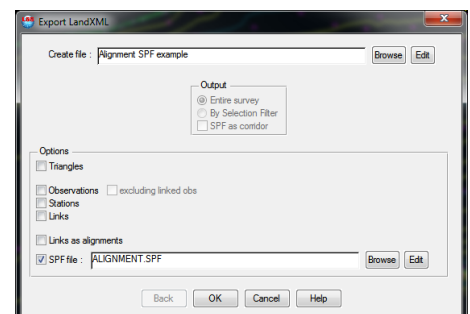


On clicking the reference line a dialog will offer a subsequent reference line to be defined or to 'End and Save'



Export LandXML / Alignments / 'SPF file'

- Input a LandXML file name
- Unset all the tick boxes apart from 'SPF file'
- The option for Entire Survey will not be available
- Browse the SPF file
- Click OK to export the alignment(s)

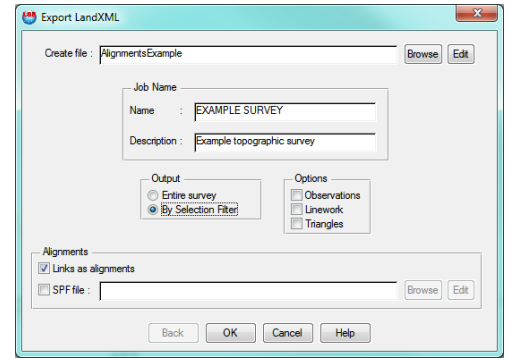


'Links as alignments' – quickly generates string following data

Unset all the tick boxes apart from 'Links as alignments'

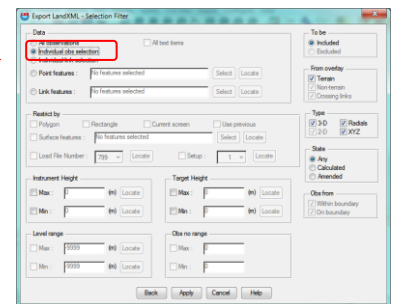
Note: LSS will automatically export each string including an incremented string number e.g. BB12.

Either;
choose the default Entire Survey
click OK



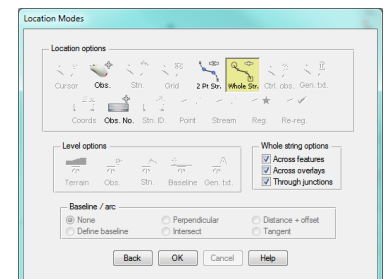
Note: Alignments by Entire Survey can be used where the extra data does not compromise the onboard processing speed and where the alignment selection process is graphical (avoiding picking items off a long list)

Or Selection Filter
choose Selection Filter for individual strings
click OK for the Selection Filter dialog
select 'Individual obs'
click 'Apply'



click the Mode button and then Whole String

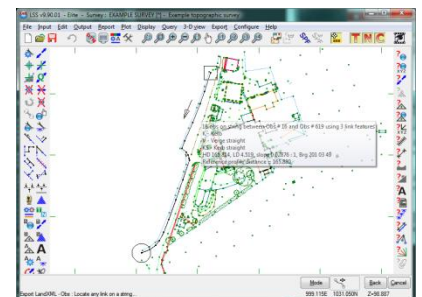
click OK



locate and Click on the string(s) required

'Esc' or 'Back' to the Selection Filter and

Finish' to complete the export



Note: LSS will automatically export each string including an incremented string number e.g. BB12. This creates uniquely named '.LIN' files on the device.

Note: Entire Survey will export all the relevant data in the model but is not generally a usable solution as it can produce a very large list of alignments names which are then difficult to scroll etc.

Chapter 3

3.1 Importing Files / Data Transfer to iCON3D

3.1.1 Telematics

First open the iCON telematics web server

Click on the Files tab

Under 'To Machine' create a new folder that will be the project name

Double click this folder to make it the working folder

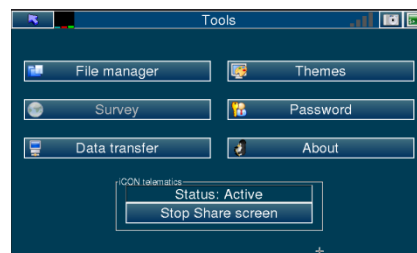
Click the '+' icon to multi-select the LandXML and DXF files to copy to the folder

Click on 'start remote session'

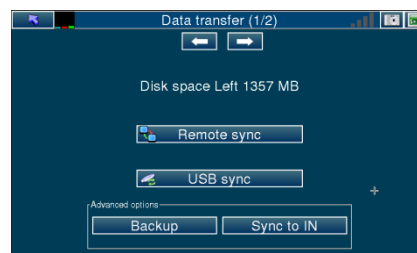
At the main menu click on Tools



Click on Data transfer



Click on Remote Sync which will synchronise the new files that you have put on the web server straight to the cab



When the Syncing is Done click 'OK'

The models are now ready to use

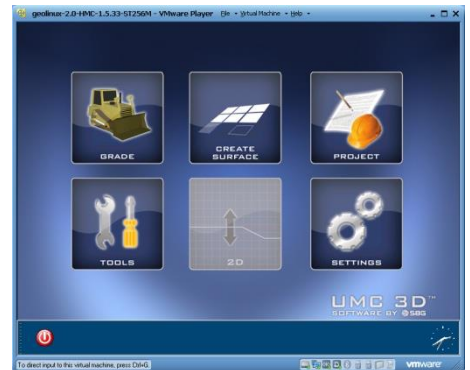
3.1.2 USB Stick

File handling

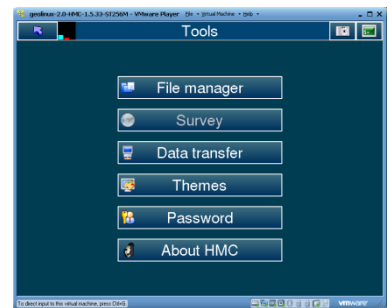
The XML and DXF files that have been exported from LSS are copied to a folder on the USB / memory stick called '*\\IN\project name*'. The following section on Data Transfer will copy the files to the device.

Main menu

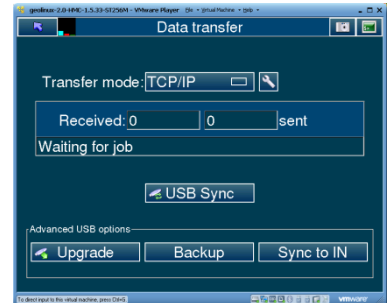
From the main menu choose Tools



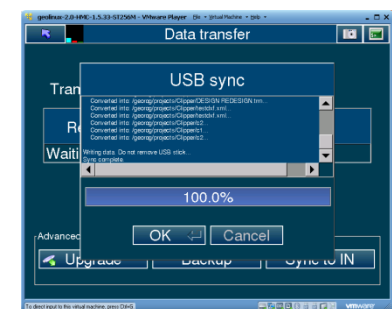
Then Data Transfer



USB Sync



This will transfer the data files (XML and/or DXF) from the USB stick into the specified project folder.



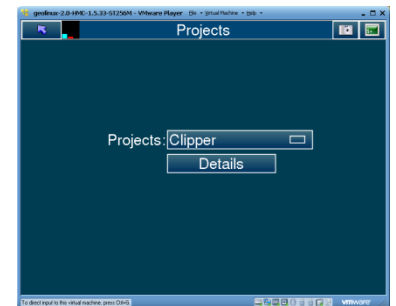
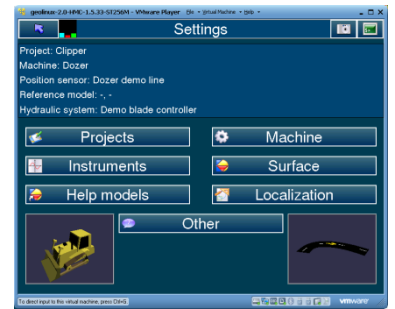
3.2 Projects

Main menu

From the Main menu choose Settings



Then Projects



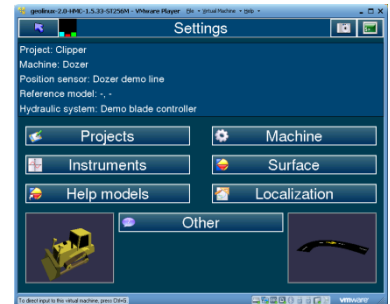
3.3 Choosing Dozer Demo Line for Simulator

Main menu

From the Main menu choose Settings

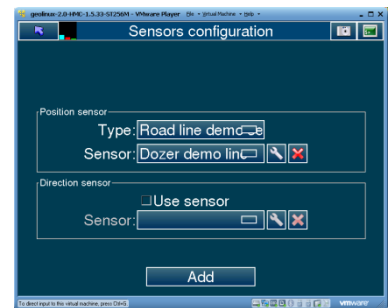


Then Instruments, then Sensors Config



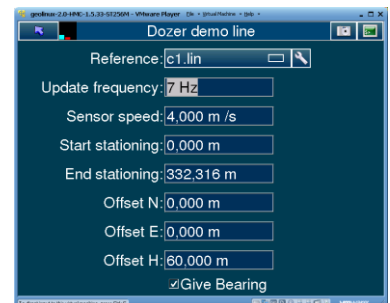
Under Sensors configuration

set the Type to be 'Road line demo'



And the Sensor as 'Dozer demo line'

Select the Dozer demo line by clicking 'Reference' and choosing the alignment from the drop down box.



Note: This is for the simulator software only and will not be needed on the machine control device itself.

Note: There are two ways to export alignments as LandXML from LSS. Either use an SPF or else choose the Selection Filter with 'Links as alignments' and select the individual strings. If multiple alignments are required and the direction/chainage of any is important then add these into a single SPF using each alignment string as a separately named 'Reference line' by Mode 'Whole string'.

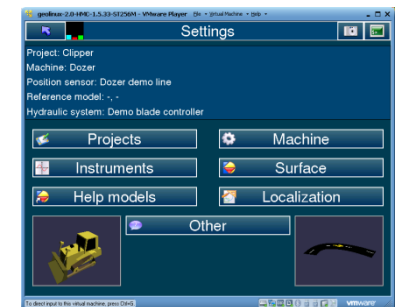
3.4 Surface Reference

Main menu

Choose Settings



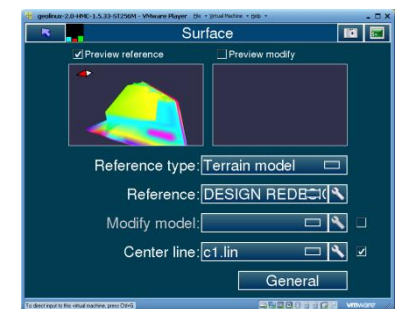
Then Surface



Set the Reference Type as Terrain model

From Reference choose the TRM which will be the description of the DTM surface exported from LSS

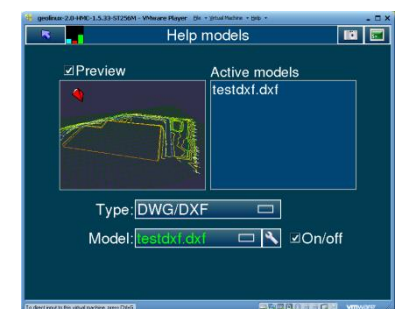
Then select the appropriate '.LIN' as the Center line. This is the line that the bucket will be referenced to with the display showing chainage (Sta) and offset (Dist).



Note: The '.LIN' files are the exported alignments from LSS via **Export LandXML 'SPF alignment' or 'Links as Alignments'**

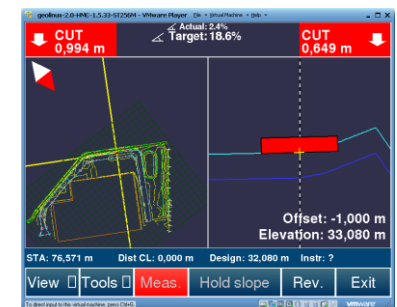
If you have exported a DXF then select this as your Help model

Note: currently this will need to be saved as a DWG to overcome an issue importing a DXF



Working within the model in plan and section view

Within the Grade screen use the Tools / Configure Model option to choose what to display e.g. Triangles



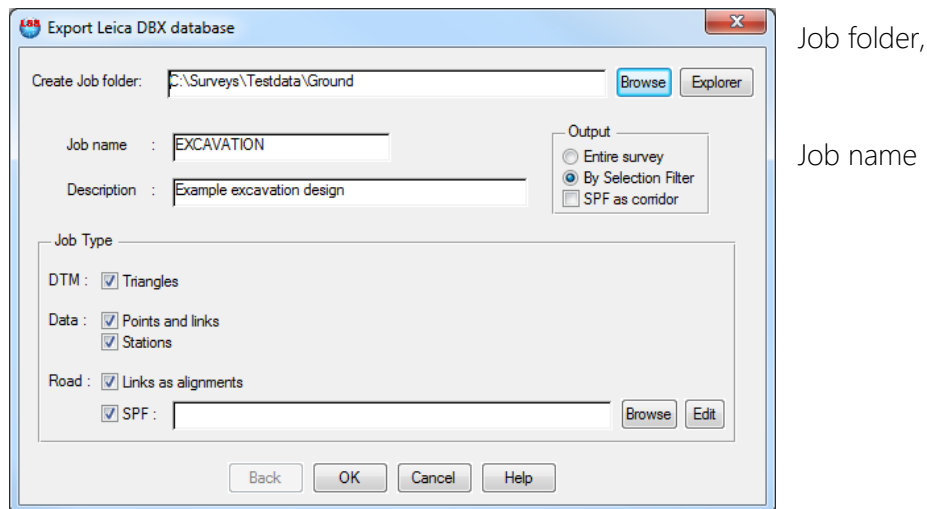
[Back to top](#)

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Chapter 4

4.1 Export Leica DBX Database

For use only with the Leica DBX platform (including Viva and Captivate). This can be used when the same models are required onboard, the surveying instruments as on the machine.



The Entire survey may be exported, or the selection filter may be used as described in the previous section. Also available is to use an LSS Section Position File (SPF) to create a corridor or envelope for the data to be included.

Three Job types are available, which all relate to the same job on the logger:

Triangles, Data and Road, complying with these types in the Leica format.

Data includes Points and Links and Stations.

The Road allows the inclusion of Links as alignments as well as an SPF.

4.2 Leica iCONstruct "Site" Export from LSS Summary

The export process includes the following data types

Triangles (DTM) – use **Export / LandXML** - imported via the Reference option – place the files in the Data folder

Points and Lines – use **Export / LandXML** - imported via the Reference option – place the files in the Data folder

Alignments ('geometry' or 'straight lines' for the machine to 'follow') – use **Export / LandXML** - imported via the Roads option – place the files in the Data folder

Codes – use **Export / Upload Code list to survey instruments / Leica Icon XML** - imported via the Codes option – place the files in the Codes folder

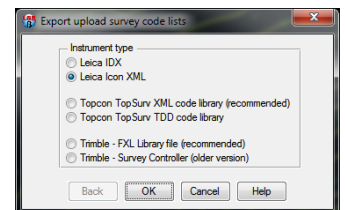
Drawing (linework and text) – use **Export / Autocad DXF** - imported via the Background Image option – place the files in the Data folder

4.2.1 Export Code Lists

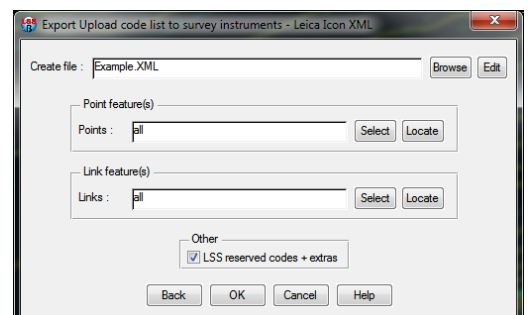
To Export a code list from LSS

Export / Upload code list to survey instruments

Leica Icon XML



Supply the new file name and select the required features



To copy the XML codelist to the iCON:

Create a "Codes" folder in your USB stick and copy your codelist file in.

Run iCON and insert the USB stick in the port.

Go to Import

Tap the green + button (bottom of the screen)

Tap on Code List row

Select Hard disk / external storage from the "From" row located under the Source Header

Select your code list and press accept.

In this way your code list is loaded in your active project.

Note: if you want to load it in other projects as well

Go to Projects

And tap on the right arrow of the project you are interested to edit

Go to second wizard step

Select the Code List option

Select Hard disk/external storage from the "From" row located under the Source Header

Select your code list and press accept.

Note: To EXPORT a code list in iCON do the following steps:

Go to Export

Tap the Content row (under the Details header)

Select Code Lists

Tap on the codelist you are interested and press accept

Select location (internal or Hard disk/external storage)

Tap on the Format (should display Copy as no file conversions yet)

Tick accept.

The code list should be stored in selected location.

Note: to export to a removable drive e.g. USB, put the code list into a folder called/created "Codes".

To be available to all projects the code list and linetype (.GLT) file must be in the Global folder

Leica 1200/Viva Code lists - Transfer all three files to the sub-folder "Codes" on the data card with iCON office using GSI transfer. When you have moved the card to the instrument,

select *<Tools/Transfer Objects/Code Lists>* from the main menu in the instrument to load the code list into the internal memory enabling you to use it.

4.2.2 Importing Data from iCON

Export the data from Icon as CSV

Convert the data to a load file in Input Convert XYZ

In Input Load use the setting 'Clear string table on change of feature' – this is because the CSV file does not hold the information related to start and end of strings – the 'clear string table' option will minimise this effect by automatically starting a new string whenever there is a change of feature – this way the only problems will happen where two strings of the same feature are exported consecutively.

4.3 Designing a Formation Model

This topic describes the combined use of Output / Surface Boundaries and Output / Survey to build a 'formation model' i.e. one that describes the shape along the top or underside of each surface feature height/depths of the current model.

The resultant formation model includes a user defined step between adjacent surface features of different height/depths which avoids anomalies (vertical sides) in the DTM and can therefore be used for machine control work and setting-out etc.

The following steps are needed to complete the process

Use File / SaveAs to create a copy of your current model

Repeat the use of Output / Surface Boundaries twice

On the first pass use a zero Internal offset distance to tidy the model. This will make sure that all surface boundaries are linked i.e. are breaklines in the DTM (this load file can also be used to supply Hatching boundaries for Autocad)

On the second pass use a small Internal offset distance e.g. 10mm, to create parallel offsets to all the selected boundary lines. This is what the Output / Survey option uses to avoid the vertical steps in the resultant formation model where the adjacent surface height/depths have different values.

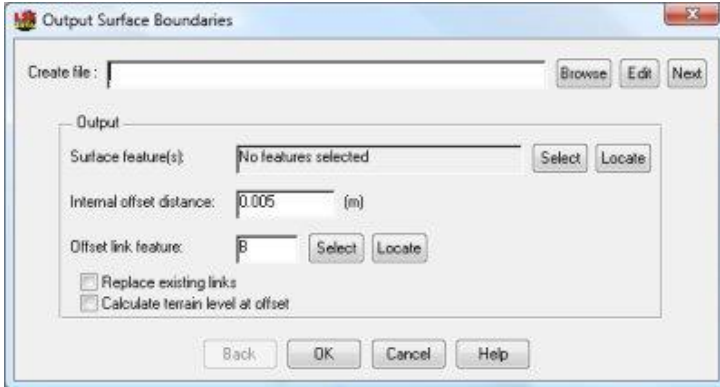
Finally use the Output / Survey command as described below. See particularly the option 'Adjust levels for surface height/depth' and the related setting 'Perpendicular to surface'

The rest of this topic describes this process in detail.

4.4 Output Surface Boundaries

This command creates parallel offsets to the selected surface feature boundaries.

It generates a series of links either on or just inside the outer edge of each nominated surface feature. These points can be given a level at either a horizontal offset or interpolated from the Terrain i.e. they are NOT assigned the surface feature height/depth at this point. The height/depth is only applied to the surface at the Output / Survey stage.



Create file - The name of the load file to create. Selecting "Next" will generate the next available number to load into the current survey. The file produced may be used to create a separate survey by specifying an alternative name. By specifying a "+" or a "-" symbol after the load file number e.g. 200- it is possible to force LSS to generate the next available load file equal to or below (-) or above (+) this number. For example the user may want to create load files in a number range. e.g. 001-050 for survey data and 100-200 for design data etc.

Output

Surface feature(s) - The name of the surface feature code(s) to output the boundaries of. The feature code can be selected or located.

Internal offset distance - The offset distance from the boundary of each Surface code.

Offset link feature - The link feature to apply to the offset points. The feature may be selected or located.

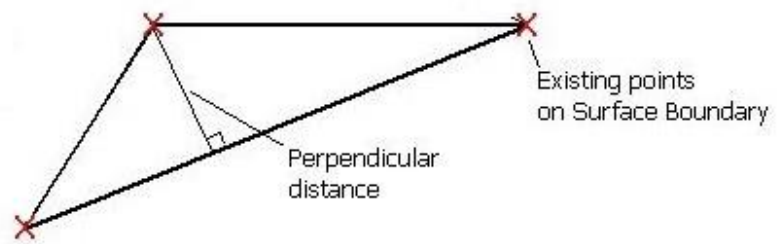
Replace existing links - This option will replace any existing links along the offset line if the offset has been set to zero.

Calculate terrain level at offset - This option will calculate the level for the new boundary points by interpolating from the Terrain.

Notes

Ignored triangles.

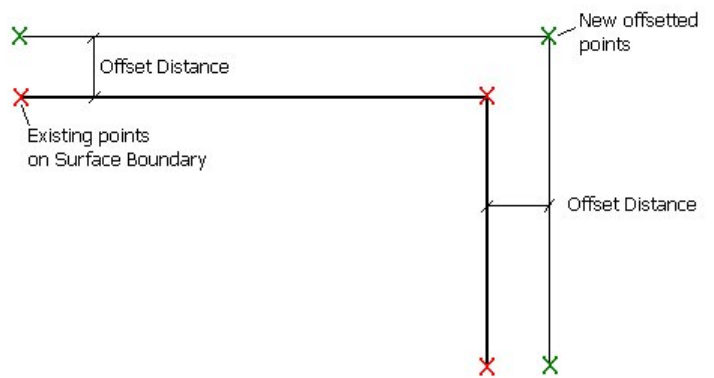
LSS will initially check the survey to see if there are any thin triangles on the boundaries of the surface codes. The tolerance for a thin triangle is 2x offset value. If a triangle is found to be "thinner" than this, then LSS will ignore it.



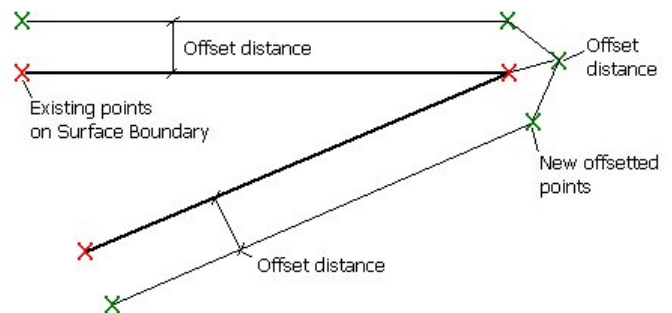
If LSS were to include this type of triangle, then seemingly rogue points could be generated. This test is not carried out when the offset value is zero.

Mitred external corners.

LSS will always mitre around the boundaries...



... except when the external angle is greater than 275 degrees. In which case 3 radius points will be created.



At the end of the output, LSS will generate a report window if...

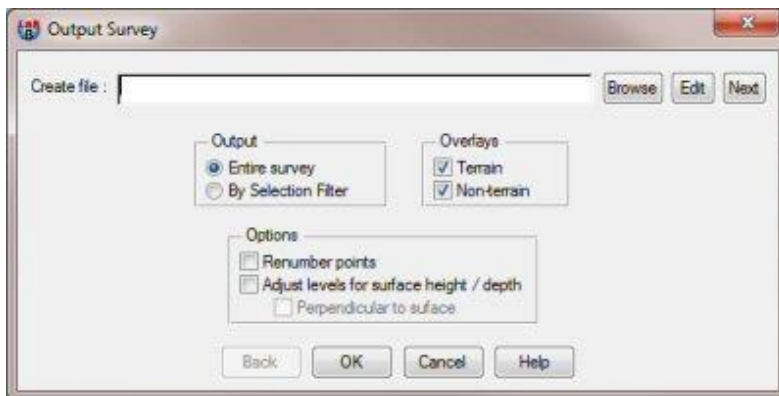
A number of surface boundaries do not have links.

A number of thin triangles have been ignored when generating the surface boundaries.

A number of points have landed in a surface feature other than that of the surface boundary being output.

4.5 Output Survey

This command produces a file of co-ordinate information in LSS load format. The only parts of a survey which are not able to be output are the surface features as these are applied manually once the DTM has been formed. If surface features are required it is recommended that 'Input / Merge / Survey' is used to import one survey into another.



Create file - The name of the load file to create. Selecting "Next" will generate the next available number to load into the current survey. The file produced may be used to create a separate survey by specifying an alternative name. By specifying a "+" or a "-" symbol after the load file number e.g. 200- it is possible to force LSS to generate the next available load file equal to or below (-) or above (+) this number. For example the user may want to create load files in a number range. e.g. 001-050 for survey data and 100-200 for design data etc.

Output

Entire survey - This option will take into consideration the entire current survey area.

By Selection filter - This option will use the LSS observation selection filter to output groups of observations.

Overlays

Terrain - Whether to include any terrain data.

Non-terrain - Whether to include any non-terrain data.

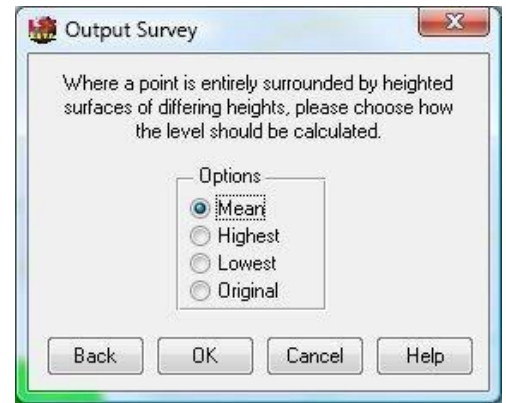
Options

Renumber points - This option will renumber the points sequentially as the data is output.

Adjust levels for surface height / depth - This option will move any points in the outputted file, to the top or bottom of the surface code they lie within, if that surface code has a height or depth.

Note: Surface boundary points are always left at the same position and level as the original points in order to maintain the volumes and areas of each surface code. This includes points on the edge of; the model itself, a "none" surface coded area, a 0m heighted surface, or a heighted surface. The use of Output / Surface Boundaries with a small Internal offset distance will maintain the shape of the formation model apart from the narrow band specified here.

When the **Adjust levels for surface height/depth** option is selected the adjacent dialog will be offered if LSS finds any points that are both entirely surrounded by heightened surface codes and where differing surface height/depths occur. LSS prompts for how this level is to be calculated. This will generally apply only to the surface boundary points themselves.

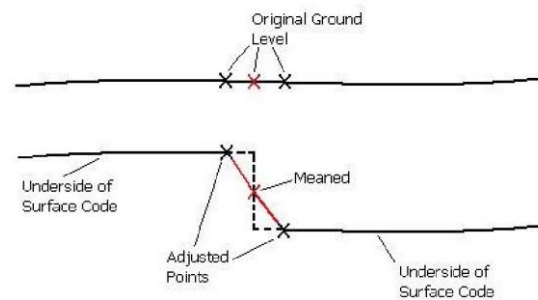


Note: Often it will be 'Mean' or 'Lowest' selected.

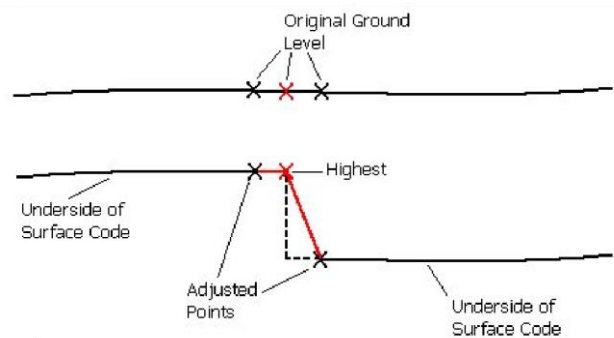
However, it is also possible to use surface features between the tram lines of adjacent surface feature depths. In this way the tram lines can either be made 'Void' to stop the triangles in this region being exported the boundary points can then be removed by Selection Feature area

Options

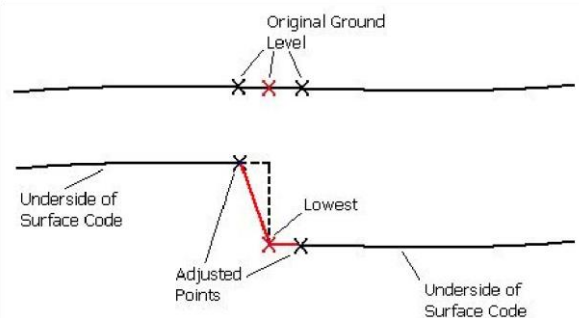
Mean - This option will calculate the mean of the highest and lowest levels.



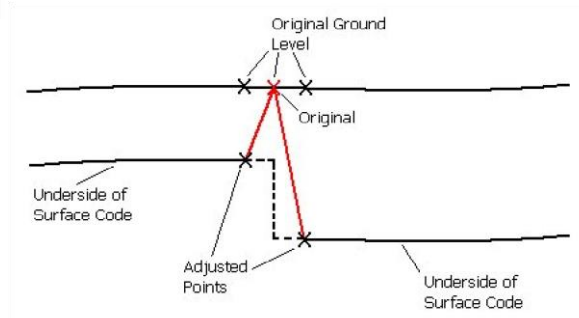
Highest - This option will assign the highest level of the boundary points to the new points.



Lowest - This option will assign the lowest level of the boundary points to the new points.



Original - This option will keep the point at its original level.



Perpendicular to surface - This option will move any points in the outputted file, to be perpendicular to the relevant surface.

When dealing with relatively horizontal surfaces the difference between a vertical depth and one which is measured perpendicular to the slope will be negligible. However, the steeper the slope, the greater will be the discrepancy and it is because of this fact that this additional option has been offered.

Here are a few rules:

Observations within surfaces will be offset perpendicular to the slope

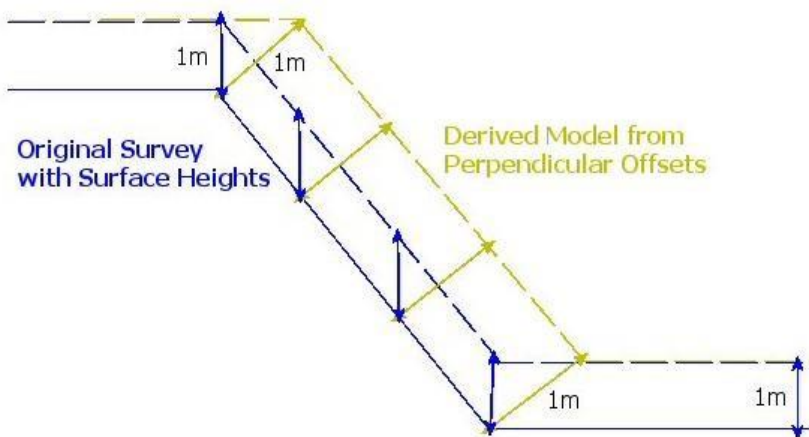
Any points on the edge of the survey, or a "none" area, or a 0m heighted surface is always at the same position and level as original, to maintain volumes in adjacent surfaces.

Any points on a surface boundary, but surrounded by surface depths, are extended vertically, and all surrounding triangles are offset, then the mean level of intersections with this line is calculated

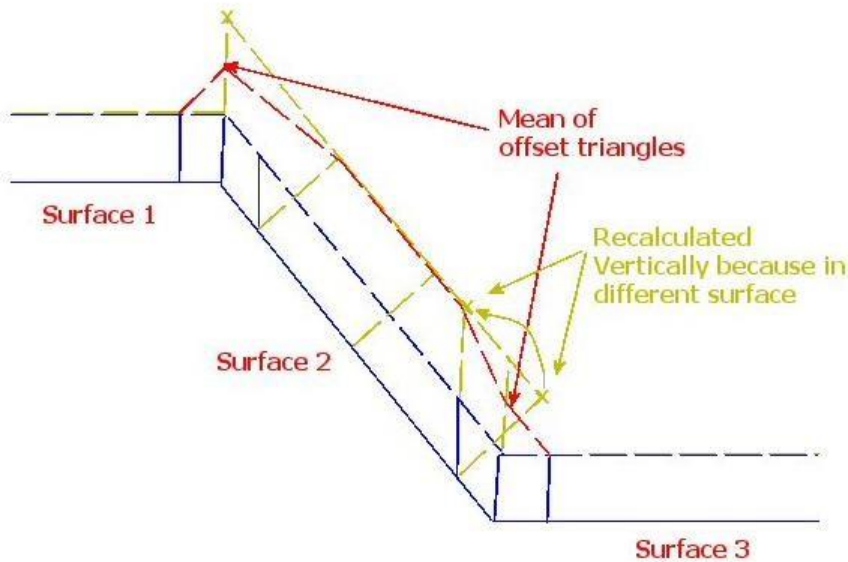
If all surrounding triangles to the point intersect the line from original to new at more than 0.1m apart (the mean is taken), then a PIN1 feature is created.

If the new point is further away in plan than twice the surface height, then a PIN2 feature code is created.

Continuous Surface Feature at a height of 1m



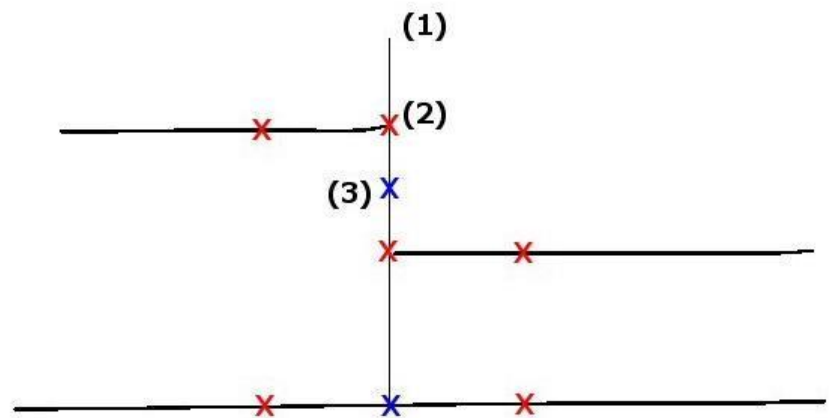
Change in surface
But all at 1m height



This line is vertical because it is on a surface boundary. This is to maintain the plan areas.

The offset triangles (by surface height/depth) in this case are calculated to intersect with the vertical line (Normally the new point is calculated to where the offset triangles intersect).

The Mean / Highest / Lowest is then taken.



Quality Assurance

When the data is outputted, some points may include a point feature such as PIN1, PIN2 or PIN3.

PIN1 - The new point is calculated based on the surrounding triangles. LSS will check between the original point to the new one and then if any surrounding triangles cross this line. A PIN1 feature is generated if any of these intersections are 0.1m away from the new point coordinates. The new point is not adjusted.

PIN2 - where the new point is further away in plan than twice the surface height.

PIN3 - where the point ends up in a different surface and is made vertical to original

Conclusion

Using this manual, we hope that you will be in a position to start making the most of the survey instrument.

We strive to cover and support as much of the capabilities as possible but there are always new methods and developments, so do keep in contact by visiting the LSS Help and other on-line resources or call our support line.

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