

FARO Interface Kit User Manual



The Leader in 3D Scanning since 1987

February 2009

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TABLE OF CONTENTS

FARO INTERFACE KIT DESCRIPTION (FA-SERIES)	5
INSTALLATION AND SETUP	6
NOTES:	6
Software Installation:	6
Hardware Installation:	6
SYSTEM TESTING	7
Motion Communication	7
Laser Communication	8
ALIGNING THE SYSTEM	9
Hard probe Calibration	9
Laser Probe Alignment	10
INTERPRETING GOODNESS OF FIT RESULTS	13
Summary:.....	13
Verifying Your Results:.....	13
Verifying Ball Scans	14
SCANNING BASICS	15
Scanning in SSC.....	15
Laser Settings	15
Setting Point Density.....	17
Typical 3D Proximity Filter Settings.....	17
Saving Data	18
Typical File Types:.....	18
APPENDIX	19
System Settings Export	20
Scan Status Indicator.....	21
Setup Diagram:	22
Geomagic Plug-in	23
Faro Alignment with Geomagic Plug-in	23
Scanning in Geomagic	27
Default Scan Settings for Geomagic Laser Plug-in.....	29
Using the Hard Probe in Geomagic	30
Detailed Hard Probe Data Collection Instructions:.....	31
Rapidform liveScan™ (BETA).....	33
Laser Plug-in Instructions.....	33
Hard Probe Instructions.....	35
Polyworks IMAlign Plug-in (BETA).....	36
Laser Plug-in Instructions.....	36
Troubleshooting- Known Issues	38
PC Maintenance	40
System Debugging:	41

Faro Interface Kit Description (FA-Series)



The Faro Interface Kit provides you with everything you need to convert your standard Faro Platinum or Faro Titanium arm into a high-powered laser scanner. Using LDI's Surveyor Scan Control you will quickly collect millions of data points which can then be used for reverse engineering and/or inspection using our Partner Software from Raindrop Geomagic.

Kit Components:

- Surveyor Scan Control(SSC)
- SLP Laser Probe
- Trigger I/F & PS/USB box
- 110V-220V power adapter for Trigger IF & PS/USB box.
- Faro SLP Probe Mount and mounting hardware
- 6 pin mini-din trigger cable
- (1) 14' right angle USB cable
- (1) 10' standard USB cable
- 110V APC Power Strip/Surge Protector (North America)
- 1" or 3" Calibration Sphere and Magnetic Base (Depending on SLP laser probe type)
- Heavy-Duty Travel Case with custom foam
- PVC Tooling Ball Kit
- New User Scan Kit
- PC- Laptop or desktop (Optional)
- SSC software USB Dongle (optional)

Other Required Components:


- Faro Platinum, Faro Titanium, Faro Quantum, or Faro Fusion arm.
- Tripod or other suitable arm mount (magnetic base, vacuum base, granite inspection table.)

NOTE:


- For a complete list of components and part number see the wiring diagrams provided or packing lists received with shipment.
- To receive spec sheets on any of the above kits or kit components, please contact your LDI representative or see the LDI website at <http://www.laserdesign.com>.

Installation and Setup

NOTES:

- Do not plug in USB devices until after you have completed the software installation. When you update the SSC software, be sure to unplug LDI USB devices during upgrade installation process.
- In general the portable CMM's operate the same as any other Surveyor system from within SSC. The main difference is that users must press record and manually move the system around to collect data. Basic scanning techniques and process still apply.
- If you have an older Faro arm which you are adding the retrofit kit to, you will want to have Faro service the arm for accurate calibration and updated firmware. Some older versions of Faro Firmware will not function properly. FARO support should provide firmware updates via email upon request.
- To launch Surveyor Scan Control double click the Surveyor Scan Control icon on the desktop  or select Surveyor Scan Control from the Windows Start Menu. If you are going to be collecting scan data directly into a 3rd Party software program, you should start that program and launch the plug-in through it.
- If you have changed moved or changed the system, you will need to complete a hard probe and laser probe calibration before collecting scan data.



- LDI now places an icon () in the system tray when any Surveyor Process is running. It can be used to terminate all processes if required by right clicking on it.

Software Installation:

1. Install Faro USB Software Driver. Available from Faro or LDI. Follow software install directions contained within install. See LDI representative for download link. Current Faro USB device driver is 5.5.4.3 (Oct 2008.) Currently there is no 64 bit Faro USB driver available (February 2009)
2. If LDI scanning plug-in will be used, install Geomagic Qualify, Geomagic Studio, Innvometric Polyworks , and/or Rapidformfirst. See LDI representative or Software Company for download link.
 - a. Install USB dongle code and/or license key if required for above 3rd party software package.
3. Using either SSC download or installation CD install Surveyor Scan Control.
 - a. It is recommended that you consult LDI for which software release of SSC to use. <http://liveupdate.laserdesign.com/download/SSC/Surveyor4429/setup.exe>
 - b. Follow the installation prompts to complete installation. Consult SSC installation instructions or Users Manual for complete instructions.
 1. When installing for the Faro Interface Kit, at a minimum you must install the following options:
 - a. Surveyor Files
 - b. SLP Laser Probes
 - c. Surveyor Manual Motion Control
 - d. Faro Encoder Latching Module
 - c. To configure SSC for you system, run the Surveyor Configuration Wizard from the Surveyor folder via the Windows Start Menu. Select the Faro Arm when prompted. Continue following the prompts until you have completed the installation.
 - d. Restart the system when prompted.
4. Install SSC Security Key as provided by your LDI representative. Plug in USB dongle if provided.
5. Copy SLP calibration files from provided CD to C:/Program Files/Laser Design/Surveyor/LUTs.
6. Once the software is installed, follow the hardware installation procedure below.

NOTE: If you are running multiple SLP laser probes models you may desire to add a second configuration via Surveyor Configuration to each model. This will allow you to quickly switch between probes with out loading default transformation matrix for each probe. This is typically completed after first configuration is fully setup and tested. Contact your LDI representative for more information and setup assistance.

Hardware Installation:

1. Unpack all components. Verify all Bill of Material requirements from the Purchase Order are met.
2. Setup Faro arm on suitable table or tripod.
3. Mount SLP laser probe mount on arm
 - a. Remove hard probe and trim ring.
 - b. Slide on SLP probe mount and align the three positive keys with the negative keys on the Faro trigger.
 - c. Using LDI provided probe mount nut to rigidly secure probe mount.
 - d. Attach hard probe to form a rigid connection. (Do not use trim ring.)
4. Mount SLP laser probe to probe mount with included hardware (3 bolts), be sure not to over tighten.

5. Connect USB cable from SLP to Trigger box. You will want to use provided cable ties or Velcro straps to mount USB cable to arm. Start at probe end and work backwards. Be sure to leave some slack at wrist and middle arm joint for arm movement.
6. Run 6 Pin Mini-din cable between Faro arm and Trigger box
7. Run USB cable between Faro arm and Trigger box.
8. Connect power cable to Trigger box.
9. Run USB cable between Trigger box and PC.

NOTE: It is very important that all USB cables (arm, trigger, and SLP probe) run through the Trigger box with USB Hub. This will insure proper function as all devices need to run on the same USB Host Controller which will have all systems running on the same PC system clock. Be sure to provide power to all USB devices before connecting to PC.

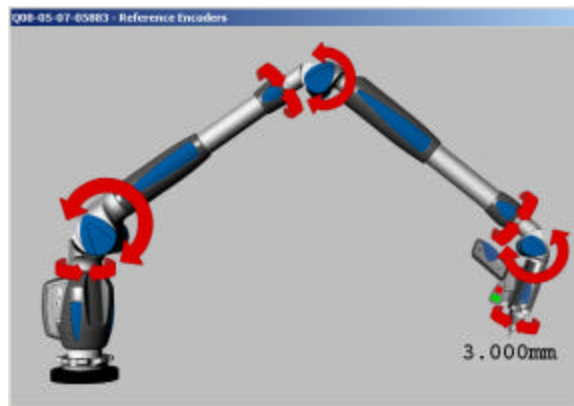
10. Plug the PC into the local area network (recommended). If the network is not plugged in, the scan software will operate extremely slowly due to Windows constantly searching for a network connection. If you are not using a network connection, it is recommended that once you start SSC you disable you network cards from windows device manager to eliminate the problem. Otherwise, simply plugging into a standard network hub will simulate a network and also eliminate the problem.
11. For driver installation see the standard installation instructions.

NOTE: In addition to using cable ties to connect SLP USB cable to Faro arm you may wish to use small cable ties to connect various cables in a neat fashion.

System Testing

Motion Communication

1. Run Surveyor Motion Control (SMC) to verify that communication to the Faro hardware is correctly functioning.
 - a. Start SMC.
 - b. When the Faro encoder Reference Encoder window is displayed move the arm joints through their travel limits and verify all joints are reference. You will see the red arrows disappear as each joint becomes reference. The window will disappear once this has been completed.



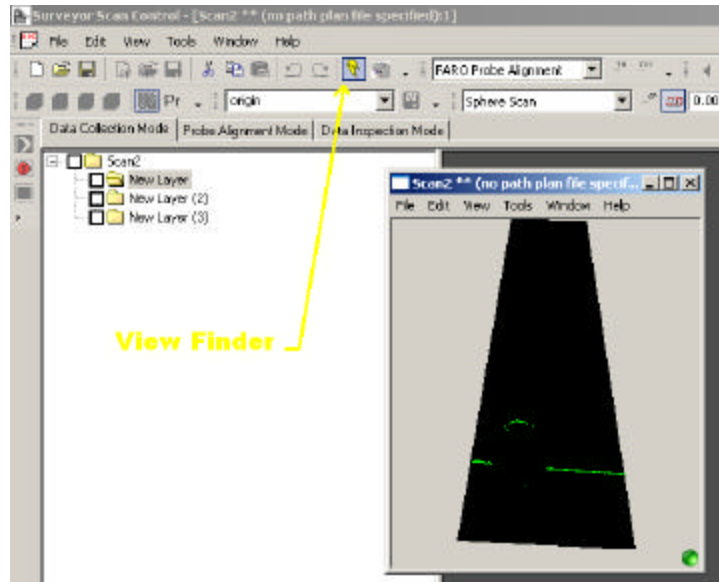
- c. When the arm is out of rest position, hit the 'WHERE' button and verify that that the X,Y,Z,A,B,C positions are updated with some non-zero value.



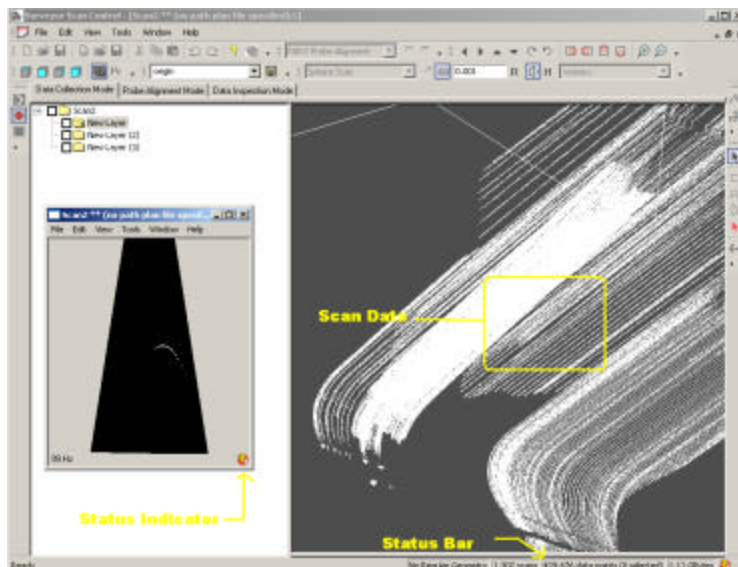
- d. Close SMC.

Laser Communication

2. Run Surveyor Scan Control (SSC) to verify that we are able to match laser scans to motion positions.
 - a. Start SSC.
 - b. Open View Finder window



- c. Move the laser over some part and verify that the View Finder window updates to reflect something in the laser FOV.
- d. Scan some object with the arm by during on record through SSC interface or green button on faro arm. Verify some data is collected by looking in the interface and/or status bar.
NOTE: this data will not be accurate and you may need to adjust your scanning parameters for different surfaces.

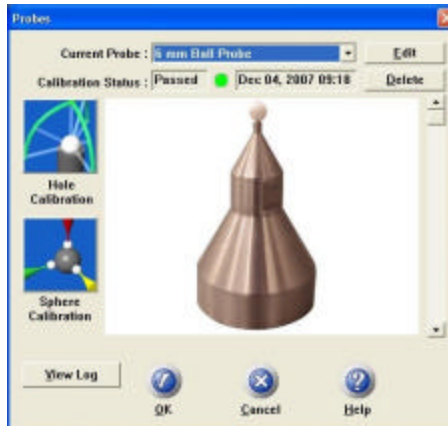


3. Once the items above have been successfully tested, continue on to Aligning the System.

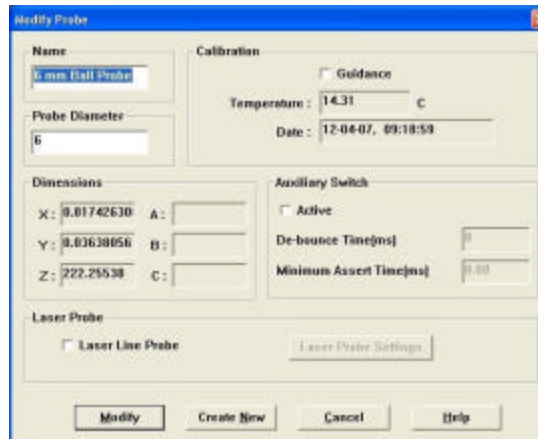
Aligning the System

Hard probe Calibration

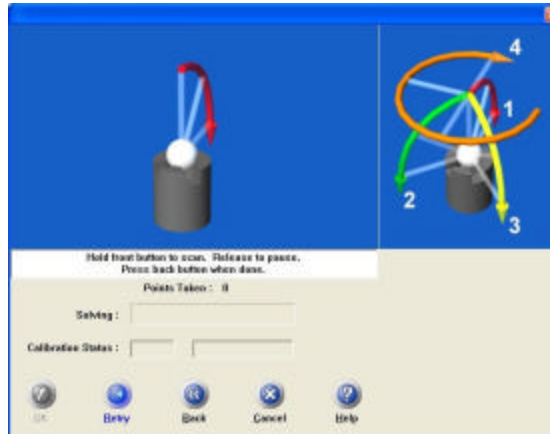
1. Before performing the laser probe alignment process, we recommend performing a probe tip qualification for the arm.
 - a. The Probe Alignment in SSC relies upon calibration of the touch probe tip to be accurate. It is good practice to run a hard probe calibration before each probe alignment to ensure accurate alignment results.
 - b. In SSC select the Probe Tip Alignment button on the Predefined Scan Parameters toolbar.
 - c. Click the Probe Dialog button. The probe Dialog will open, though it may pop under the SSC window.
 - d. In the Probe Dialog, select the ball diameter for the Faro probe (usually 6mm).



- e. Click the Edit Button to go to the Modify Probe Dialog. Be sure the Guidance box is unchecked.



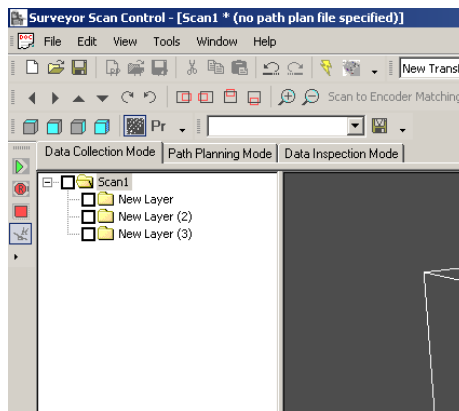
- f. Return to the Main Dialog page and select the Hole Calibration button.
 - g. Use the Faro Provided hole target, or an appropriately sized hole to complete the Hole Calibration procedure as instructed by the dialog. The target must be rigidly mounted so that it does not move relative to the arm base.



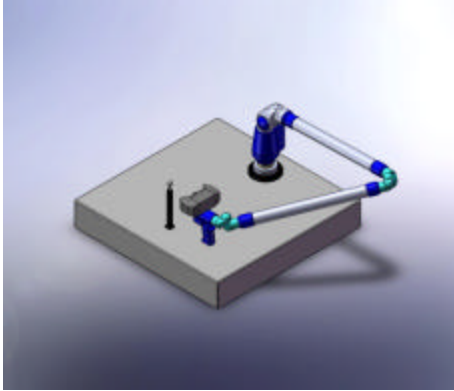
- h. After verifying a successful calibration, click the OK button.
- i. Click OK in the main Dialog, and then close the SSC settings windows to return to SSC.

Laser Probe Alignment

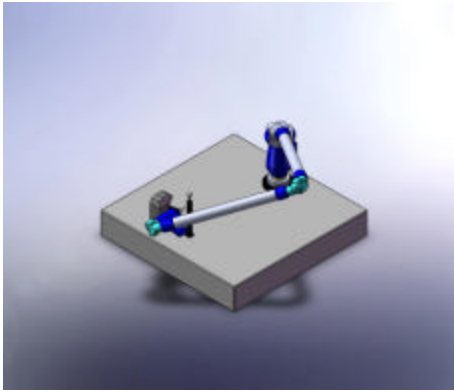
2. Laser Probe Alignment in SSC
 - a. Rigidly mount the alignment sphere so that it will not move relative to the Faro Arm base. Choose the sphere size to match your probe model:
 - i. 1" sphere for SLP250, SLP330, SLP400, SLP450, & SLP500
 - ii. 3" Sphere for SLP 2000
 - b. Your software should be setup with a Scan Parameter set specifically for Probe Alignment. Some settings will depend on the type of laser you are using (exposure time for example), but certain settings must be in place for the probe alignment procedure to work properly:
 - i. Scan spacing: Set to Approximately 1/100 the Sphere Diameter
 - ii. Sensor: Use 0 & 1 Separated
 - iii. Turn all 3D Filters off
 - c. Set up 3 new sublayers under the current document's Root layer.



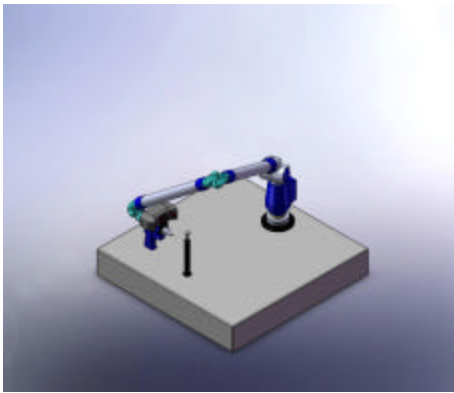
- d. Select the first sublayer and prepare to scan the first sphere
 - i. The idea here is to scan the sphere from the 5 available quadrants of the sphere with as many arm positions as possible.
 - ii. As a guideline, follow the procedure outlined below.
- e. For the first layer keep the arm's shoulder rotated to the right and as close to horizontal as possible.
- f. Start by scanning the Right side of the sphere. To aid in scanning, be sure the View Finder is turned on.



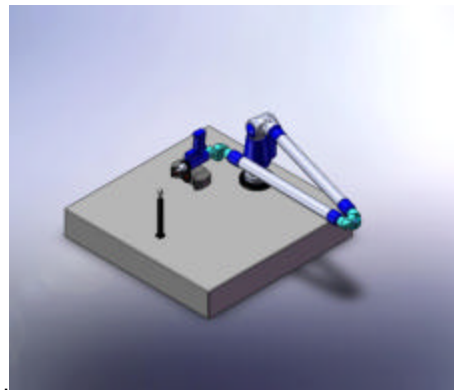
g. Next, scan the Front of the sphere.



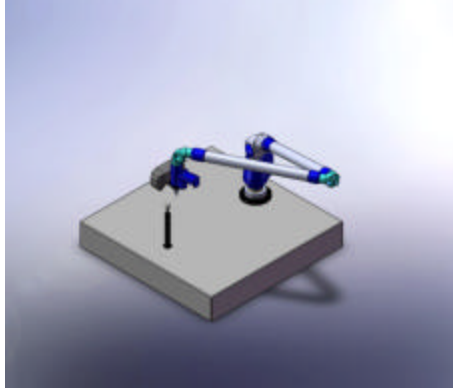
h. Next, scan the Left side of the sphere.



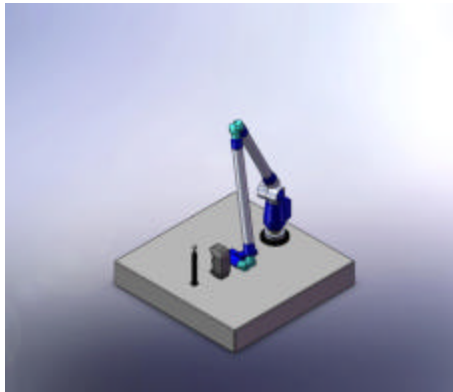
i. Next scan the Back of the sphere



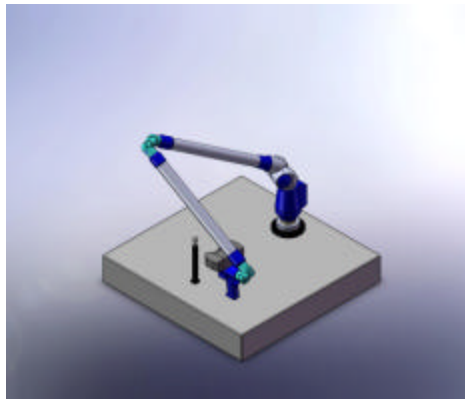
j. Finally, scan the Top of the sphere.



- k. Move to the second sublayer. Repeat the process from above, this time keeping the arm shoulder in the upright position.



- l. Move to the third sublayer. Repeat the process from above, this time keeping the arm shoulder in the left position.



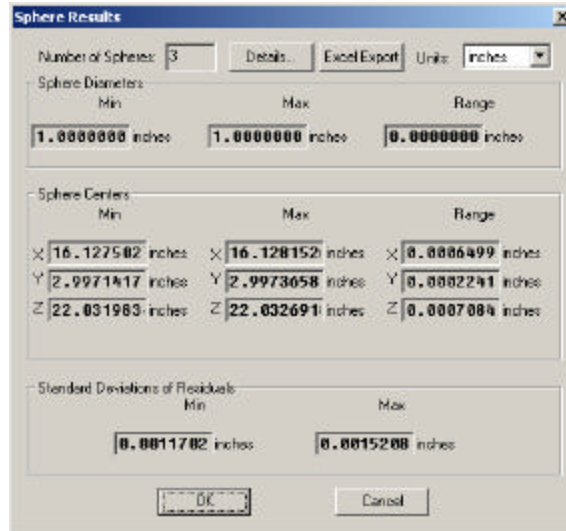
- m. Turn on all 3 sublayers and delete an extraneous data that is not on the sphere. This will help speed the calculations.
- n. Select the root layer and right click. From the context menu, select Compute from Sphere Scans/Probe Alignment and Sensor Correction.
- o. Set the Sphere Diameter to the proper size.
- p. Select the default Transformation Matrix.
- q. Be sure all Sensor Correction Factors are selected.
- r. When the function is completed a Goodness of Fit dialog will open, showing you the quality of your results.
- s. Review the Goodness of Fit dialog,
- If they are acceptable click ok to accept and you can begin scanning.
 - If they are ok, click ok to accept and repeat Laser Calibration process.
 - If they are not good, you will need to load a 'good' rough transformation matrix to complete your laser probe alignment. Contact your LDI representative for detailed instructions.

Interpreting Goodness of Fit Results

Summary:

Whenever you run a Laser Probe Alignment or Ball Matching Wizard, Surveyor Scan Control will open a **Goodness of Fit** dialog. This dialog gives you key information about how accurate the results are from the function you just ran.

The example below shows a dialog from an **Alignment Wizard**. The dialog shows information about the spheres, and their locations after the function has been run. It is important to remember that in an ideal situation, each sphere scan should have the same position value after the function is run. In other words, the **Sphere Centers - Range** values in a perfect system would be zero.



1. The **Number of Spheres** value indicates the number of positions the sphere(s) was scanned from, and therefore the sample size for the calculations.
2. The **Sphere Diameters** values indicate the min, max and total range in sphere diameters for the various fits. If you specified **Use Known Diameter** for the fit sphere settings, the sphere size is fixed, and the Range value will be Zero.
3. The **Sphere Centers** values indicate the min, max and total range X, Y, and Z values for the distance between sphere centers. Ideally, the total values should equal Zero.
4. The **Standard Deviation of Residuals** values indicate the minimum and maximum standard deviation of the data that was used (selected) to fit the spheres. Minimum values usually correspond to data taken from the middle of the Field of View of the laser plane. Maximum values usually correspond to data take from the edges of the Field of View.

Verifying Your Results:

Results will vary depending upon your laser model, arm model, amount of data collected, and amount of variations introduced with arm positions and areas of laser FOV. Should your results be worse than the values below, first check your data as described in the Verifying Ball Scans section. If the data was OK (i.e. if the spheres were fit properly), your laser or arm may need recalibration.

LASER MODEL	SPHERE CENTERS RANGE (Probe Alignment)		STANDARD DEVIATION MAX (Probe Alignment)	
SLP 250	0.0010 in	0.0254 mm	0.0010 in	0.0254 mm
SLP 330	0.0020 in	0.0508 mm	0.0020 in	0.0508 mm
SLP 400	0.0020 in	0.0508 mm	0.0020 in	0.0508 mm
SLP 450	0.0025 in	0.0635 mm	0.0025 in	0.0635mm
SLP 500	0.0030 in	0.0762 mm	0.0030 in	0.0762 mm
SLP 2000	0.0060 in	0.1524 mm	0.0060 in	0.1524 mm

SLP250 AND SLP500 are currently estimated values

Verifying Ball Scans

If you have just run a Wizard and have gotten suspect results, it is a good idea to check your data to make sure that the right data was used to fit the spheres required for the function you ran. Sometimes, some geometry that is not part of the sphere will be scanned and may confuse the sphere fitting algorithm. Usually, such cases are indicated by an extremely large **Sphere Centers - Range** value, accompanied by a large **Max Standard Deviation of Residuals** value.

To identify which sphere is the problem, simply set Surveyor Scan Control to **Data Collection mode**, and click on each ball data **layer** successively. A layer that shows an unusually large Sigma value on the Status Bar is likely to be the sphere that is causing the problem.

Figure 1 shows a situation where extra data has confused the sphere fitting algorithm. Notice how the sphere has been fit to data that is not really part of the tooling ball we scanned.

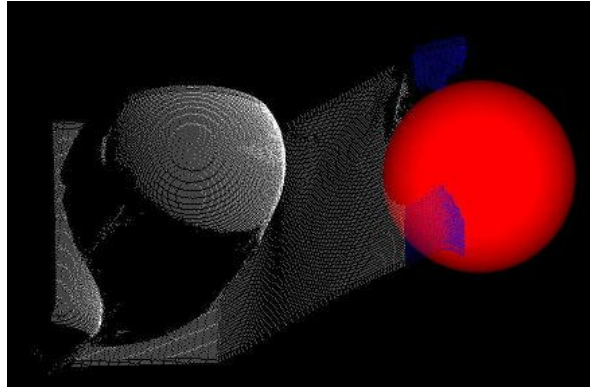


Figure 1

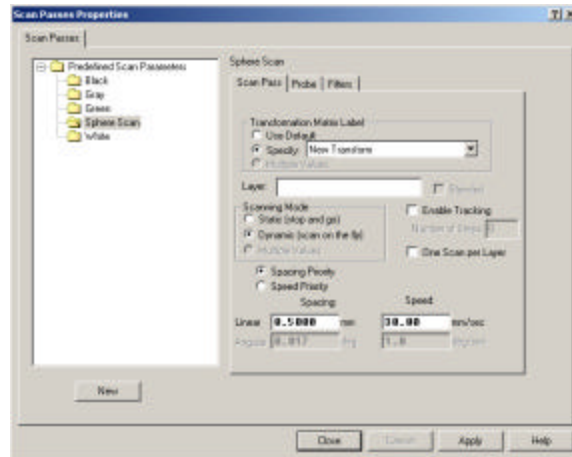
To fix this simply select and delete the data that is not associated with the **tooling ball** you intended to scan. Next, once you have identified all problem layers and deleted the interfering data, select the parent layer of the data, right click and run the appropriate function from the pull-down menu. Rerunning the function will result in refitting the spheres to the data in all layers before running the alignment, calibration, or ball match function. Therefore your results will improve.

Scanning Basics

Scanning in SSC

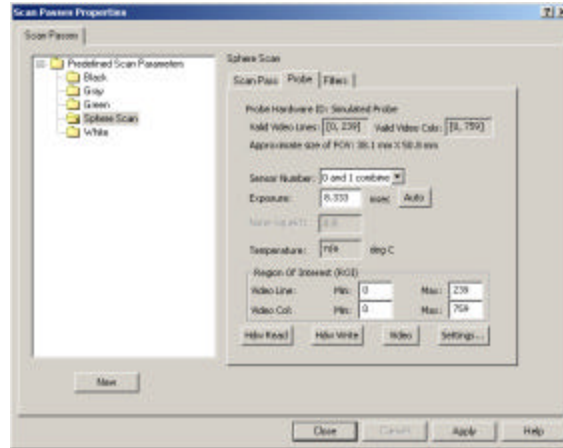
1. Start SSC
2. Open View Finder
3. Select Predefined Scan Parameters from drop down menu for part type and color. (Adjust if necessary.)
4. Turn on, reset, and adjust 3D proximity filter as appropriate.
5. Create Sublayer(s) if desired.
6. Use Record button in SSC or on Faro arm to scan part or position of part.
7. Repeat steps 3-6 as needed until entire part has been digitized.
8. Save entire file as an SSC file.
9. Export scan data as desired.

Laser Settings



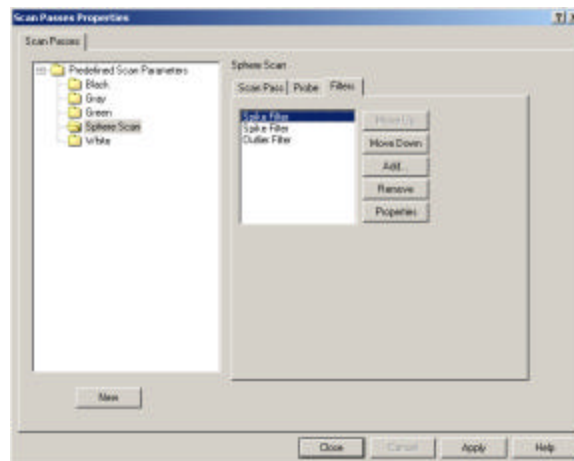
Tab 1

- Scan Passes: Depending on the setup of your system, the number of Predefined Scan Parameter types will vary. Upon setup, your system will have some basic options. As you scan different surfaces, it is recommended that you copy and paste the closest setting to what you are scanning and adjust for the new part surface. Once created, the various options will remain until you delete them.
- Transformation Matrix Label: You should have only one transformation matrix available. Setting can be 'Use Default' or Specify to the only option.
- Layer: Always Blank
- Blended: Always Grayed out.
- Scanning Mode: Always Dynamic.
- Enable Tracking: Always off
- One Scan per Layer: Always off.
- Priority: Typically always Spacing Priority
- Noise squelch: Typically set to .21 (0 is off, .2 is only accept mid level intensities, .5 accepts only high level intensities.)
- Spacing: Typically Linear Spacing settings:
 - .001" - small sized, high detailed objects like coins or carvings
 - .005" - medium sized, high detailed objects like plastic parts
 - .010"- medium sized, medium detailed objects like a helmet
 - .020"- large sized, medium detailed objects like a helmet
 - .050"- large sized, low detailed objects like a car body
- Speed: Automatically updated when Linear Spacing is adjusted.



Tab 2

- Probe Information: The software will automatically read in probe ID #, valid video lines and rows, and approximate FOV size.
- Sensor: Typically use 0 and 1 combined for all scanning except sphere scanning which must be set to 0 and 1 separated.
- Exposure: Depending on the probe type and surface (color, texture, finish, etc...) the exposure selected will vary. However, below are some basic guide lines.
 - 0.1-2.0 White or other very light surface
 - 0.5-2.0 Light Gray, Light Brown, Light Blue, Light Green, Aluminum, or other light surface
 - 1.0-4.0 Medium Gray, Medium Brown, Medium Blue, Medium Green or other medium surface
 - 2.0-8.0 Dark Gray, Dark Brown, Dark Blue, Dark Green or other Dark surface
 - 6.0-12.0 Black or other Dark surface
- ROI: These numbers can be adjusted to shrink the size of the laser ROI. Contact your LDI representative or see Help File for more information.



Tab 3

- Typical 2D Filter settings:
 - 75 deg Spike Filter
 - 135 deg Spike Filter
 - .025" Outlier Filter (this is subject to your 3D proximity filter)

Setting Point Density

When scanning a part from several positions, you ensure that you will get point coverage on most a part's geometry, even if it is hidden from view in certain positions. A potential drawback of this that on the flat areas of the part, you will get data from all positions combined in the same area. This effect can be used to help reduce scan density, but it can also result in some point redundancy. This in turn results in large data files that need to be filtered when brought into 3rd party software packages. With this in mind, it is important to understand how to properly set point **spacing** for a scan.

There are two main factors that determine 3D point spacing in a scan file; 2D point spacing along the scan line, and 3D spacing between scan lines. A third, less obvious factor is the number of scan positions that will view the same area of the part. When combined, you can get a pretty good idea of the 3D point spacing before you begin a scan.

2D point spacing along the scan line is fixed, and is determined by the laser you are using. Each laser collects 240 points along its line, so determining point spacing is a simple matter of dividing the line length by 240. The line length, of course, varies. The nearer to the laser you are, the shorter the line, and therefore the higher the 2D point density. In general you can count on densities for the various lasers as follows: RPS 450 = .0036", RPS 150 = .0012", RPS 120 = .0008". If you wish, you can apply a 2D **thinning filter** to the data during the scan. Doing so will increase the point spacing along the line to your requested tolerance by throwing out points.

2D spacing between scan lines is set during **path plan** setup. To determine scan spacing, you'll need to determine the minimum feature size you wish to measure. Set your spacing to at least 1/4 the minimum feature size for a single position scan. If you will scan from more than one angle, you may be able to increase the spacing some, due to overlap from the various positions. You will need to examine your part carefully to determine which areas will get coverage from multiple positions.

The number of Scan Positions that will view a region can be used as an indicator of how much more dense your finished scan will be than any one of the positions. If, for example, you scan a part with spacing of 0.012" from 4 positions, you might expect an effective point spacing to be close to 0.003" to 0.004". This will, of course, also depend upon the 2D point spacing to some degree. As long as the scan spacing is much larger than the point spacing, point spacing may be neglected.

Surveyor Scan Control also provides a **3D Proximity Filter** for reducing point cloud density. This filter checks the distance between points and deletes points that is within a tolerance value from each other. In this way, redundant data can be deleted, while maintaining important feature data. Be sure when setting the 3D proximity Filter to specify a tolerance less than or equal to your desired point spacing.

Typical 3D Proximity Filter Settings.

- .002" - small sized, high detailed objects like coins or carvings
- .008" - medium sized, high detailed objects like plastic parts
- .010"- medium sized, medium detailed objects like a helmet
- .025"- large sized, medium detailed objects like a smooth car body part
- .050"- large sized, low detailed objects like a car body

Saving Data

1. Save entire Data file, select either **Save** or **Save As** from the File menu or toolbar. The default file format is Surveyor Scan Control's compressed .SSC format. It is recommended you save the entire data file in case you ever need to get back to the original data set.
2. Save just the desired point cloud. Click on the sublayer of which ever data set you desire. Right click and select 'Save Layer As' pick a file location, file name, and file type. NOTE: If there are additional sublayers (child layers) below the sublayer you export, all sublayers will be included in exported data.

Typical File Types:

SSC File Format: The SSC file format is Laser Design's proprietary file format used exclusively by Surveyor Scan Control. The SSC format contains information about each data point and its associated scan, plus layer information, and other critical Surveyor Scan Control information such as Orientation Matrices. This format is highly compressed. SSC files are the only data files Surveyor Scan Control can open.

PSL File Format: The PSL file format is one of the latest file formats which was specifically developed to work with Innovmetric Polyworks Modeler and Inspector. PSL files are compressed, containing, file structure, XYZ coordinates, and point normals.

SCN File Format: The SCN file format is an older, proprietary Laser Design format from the original Data Sculpt software. SCN files are also compressed, and are generally smaller in size than SSC files. The SCN format is supported by Raindrop Geomagic software, and is the preferred format for transferring scan data into Geomagic, due its small file size.

PCN File Format: The PCN file format is proprietary Laser Design format which improves upon the SCN file format. This format contains all of the information of the SCN format as well as includes point normal information. The PCN format is supported by Raindrop Geomagic software (Versions 5 and later), and is one of the preferred formats for transferring scan data into Geomagic, due its small file size.

ASC File Format: The ASC file format is the industry standard ASCII format for point clouds. Most 3rd party software packages will read ASCII, though the point cloud is completely disorganized and uncompressed. ASC files tend to be extremely large in file size.

MGP File Format: The MGP format is designed specifically to be used with Raindrop Geomagic (Versions 7 and above) which includes ordered data points with point normals.

Appendix

System Settings Export

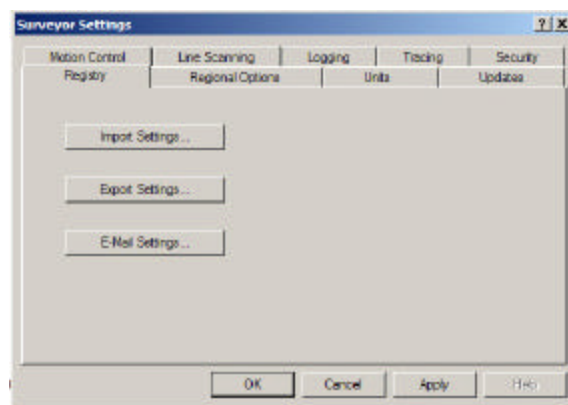
All system settings for **Surveyor Scan Control** are saved in the Windows Registry. Each time Surveyor Scan Control is launched, the system settings are recalled from the registry. In this way, personalized settings, and hardware settings like transformation matrices and rotary calibration data may be retained each time the software is loaded.

When you have the software set up to your liking, Laser Design recommends that you export your **registry settings**, so that you can restore them later if needed for what ever reason.

Registry settings are also important when resolving issues encountered when using the software. By sending your current registry settings to Laser Design application engineers when you encounter a problem, we can quickly emulate your system and work to resolve the problem.

Registry files are exported in the .txt format to allow easy transfer over email (.reg files are often removed by virus scan software and internet firewalls). Surveyor Scan Control also prevents you from importing a registry file that is not a Surveyor Registry file, thereby preventing serious mishaps.

Importing and Exporting Registry Settings:







1. Open Surveyor Settings and go to the **Registry** tab.
2. To import previously saved settings into the current session of Surveyor Scan Control, click the Import Settings button.
3. To Export the current settings to a file, click the Export Settings button.
4. To email the current settings to LDI Engineers for troubleshooting, click the Email Settings button.

NOTE:

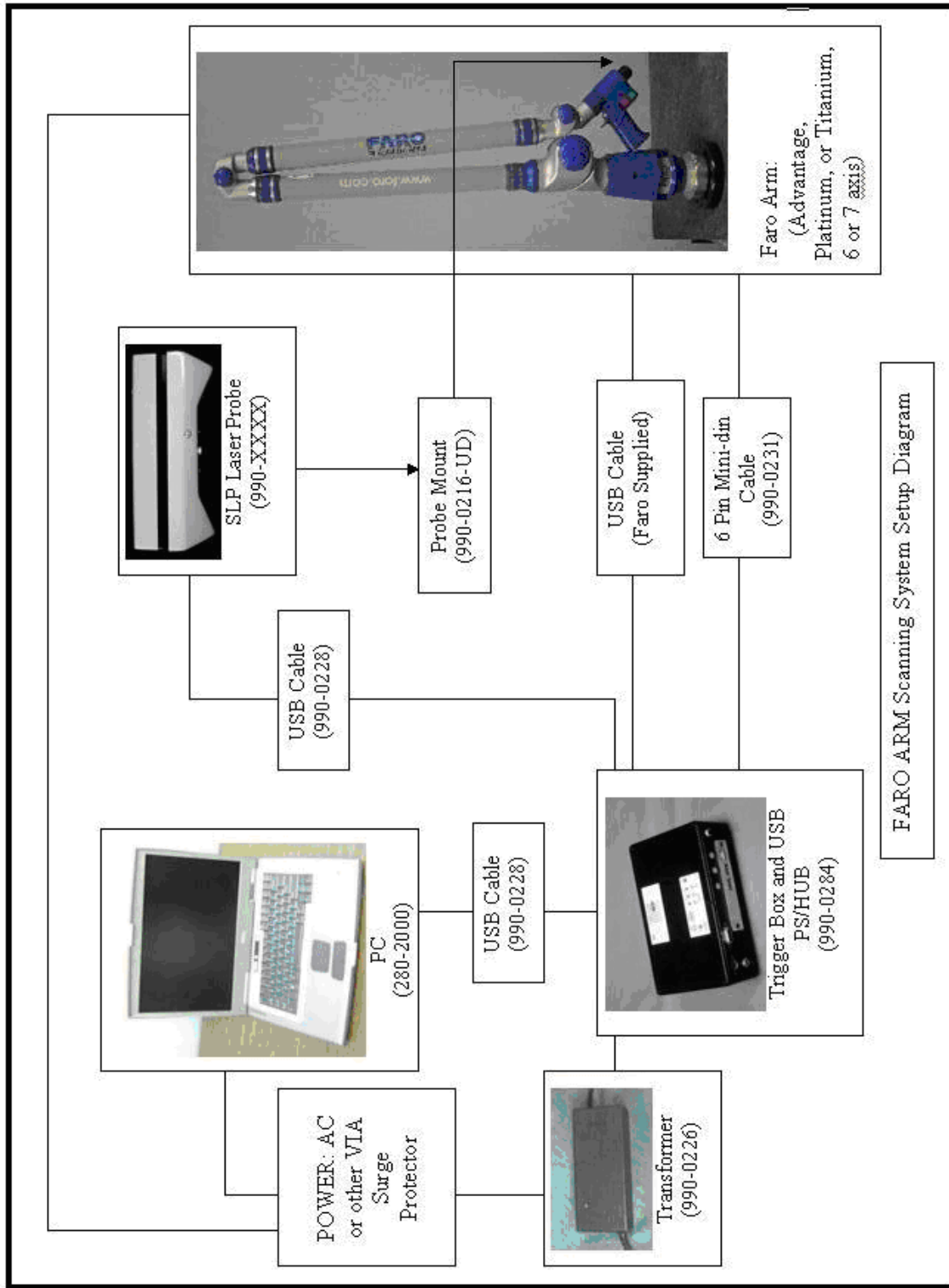
- If you are already in Surveyor Scan Control, there is a similar option under the 'File' Menu.
- It is also highly recommended to exit out of Surveyor Scan Control, **Surveyor Motion Control**, and/or **Surveyor Configuration** after importing a new registry as some items can not be updated while the software is open.

Scan Status Indicator

The Scan Status Indicator is a small icon in the lower right corner of the Surveyor Scan Control window. The indicator is situated at the far right side of the **Status Bar**. The Scan Status Indicator shows what the status of the software is at any given moment. For example, it can show if the system is currently scanning. Below is a list of the status indications used in Surveyor Scan Control.

Indicator	Status
	Ready. You may perform any function within Surveyor Scan Control.
	Dynamic Scan Window Open. The software is displaying a real time view of data in a dynamic scan window, usually in a Wizard.
	Moving. Motion Control is completing a move, but the software is not scanning. For example, if you have commanded a move, or if the scanner is indexing from a stop position to a start position during a preprogrammed scan.
	Scanning. The system is executing a scan. Indicates that either the Start Scan button, or the Record button has been pressed, and scanning is currently active.

Setup Diagram:



Geomagic Plug-in

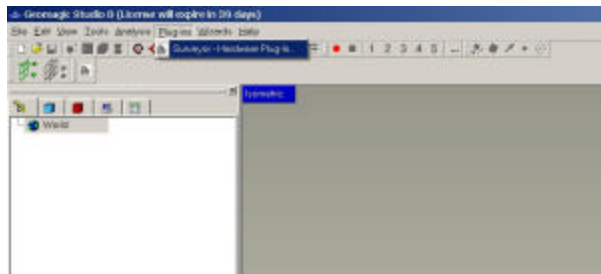
SSC comes with a software plug-in that allows you to scan from within Geomagic Studio or Geomagic Qualify directly. When using this plug-in, SSC will run in the background to collect data that is rendered inside Geomagic. In addition, the plug-in allows you to use some of the touch probe capability of your arm, so that you can combine scan data with touch probe data.

Before using the plug-in, be sure your arm has been calibrated in SSC (calibration in Geomagic is currently under development.)

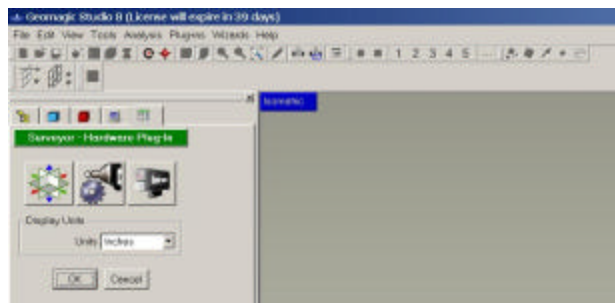
Faro Alignment with Geomagic Plug-in

The Geomagic Plug-in allows you to perform laser alignment without running Surveyor Scan Control. Follow these simple steps to align the laser in Geomagic.

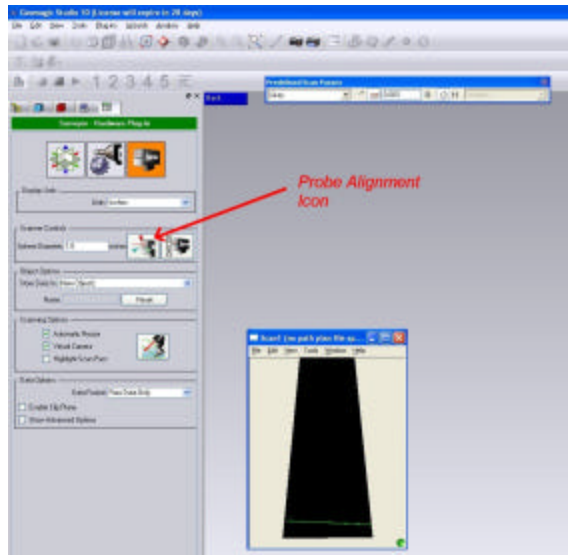
1. Inside Geomagic, select Plug-ins/Surveyor - Hardware Plug-in.



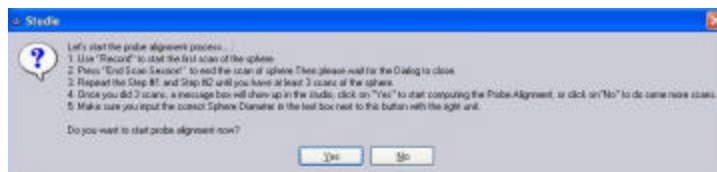
2. The Surveyor Hardware Plug-in dialog will open.



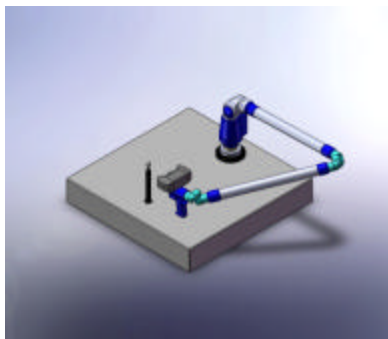
3. Click the Laser Capture button to open the Laser Scanning dialog.
4. Select the proper scan parameters from the Predefined Scan Passes toolbar. The Scan parameters you use must be set to use Sensors 0 & 1 Separated.
5. Click the Probe Alignment Icon. (Available in SSC versions 4.4.031+ and 4.5.008+)



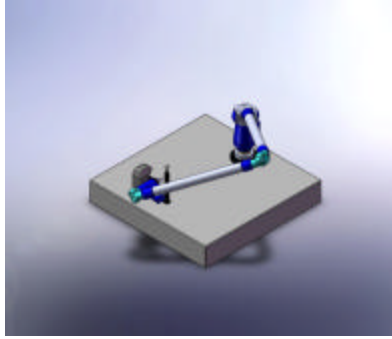
7. The following dialog will open. Click the Yes button to begin alignment.



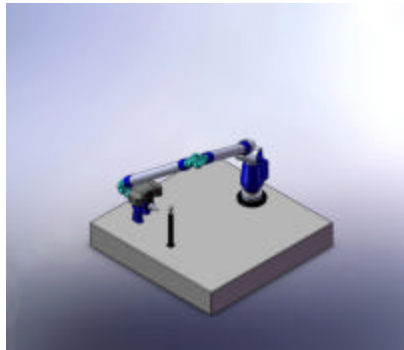
8. Follow the instructions in the dialog for the alignment process.
9. Scan the sphere the first time. The idea here is to scan the sphere from the 5 available quadrants of the sphere with as many arm positions as possible.
10. As a guideline, follow the procedure outlined below.
 - a. For the first layer keep the arm's shoulder rotated to the right and as close to horizontal as possible.
 - b. Start by scanning the Right side of the sphere. To aid in scanning, be sure the View Finder is turned on.



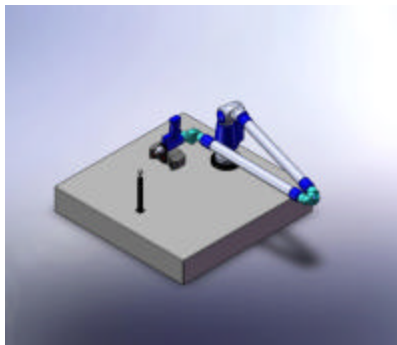
- c. Next, scan the Front of the sphere.



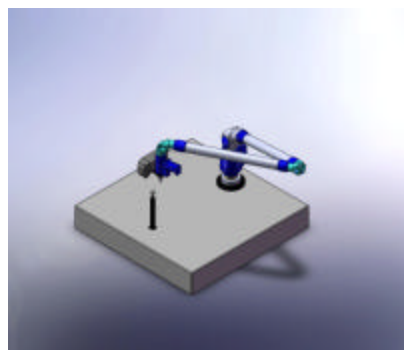
d. Next, scan the Left side of the sphere.



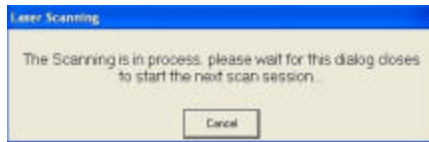
e. Next scan the Back of the sphere



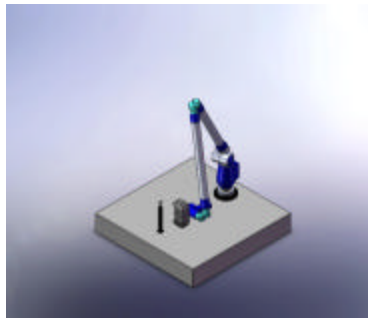
f. Finally, scan the Top of the sphere.



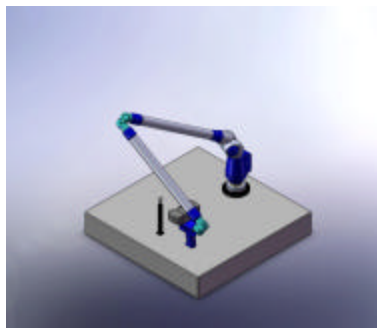
11. Click the rear button on the arm to End Scan Session. The following dialog will appear:



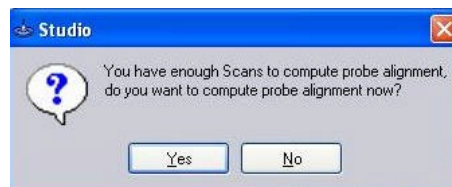
12. This dialog will automatically close, at which point you can move on to scanning the sphere a second time.
13. Repeat the process from above, this time keeping the arm shoulder in the upright position.



14. Click the back button when done scanning the sphere for the second time and wait for the dialog to close. Now you can start scanning the sphere one last time.
15. Repeat the process from above, this time keeping the arm shoulder in the left position.



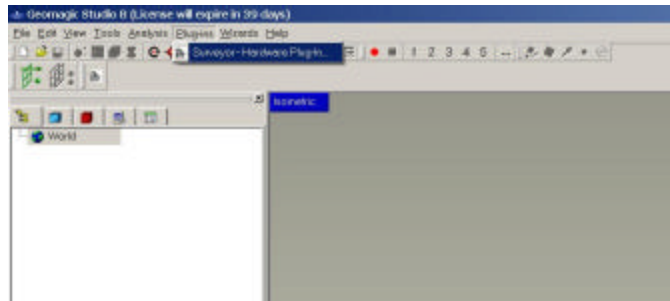
16. When you are finished with the final sphere, click the Back button one more time. The following dialog will open.



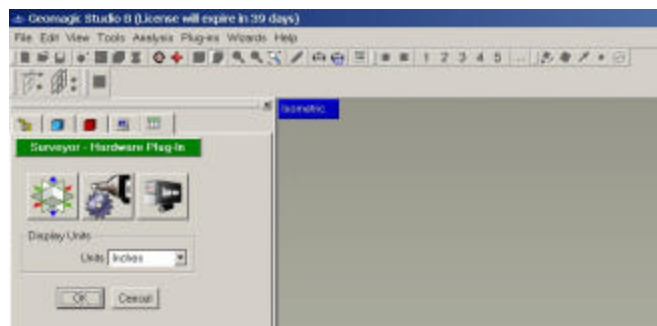
17. Click yes, and wait for the system to complete the calculation.
18. When calculation is complete a Goodness of Fit dialog will open, showing you the quality of the alignment results.
19. Close the Goodness of Fit Dialog, and then close the Plug-in. You are now ready to scan.

Scanning in Geomagic

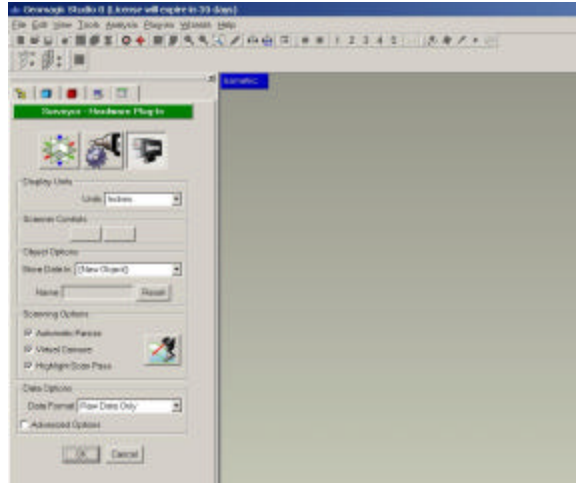
1. Inside Geomagic, select Plug-ins/Surveyor - Hardware Plug-in from drop down plug-ins menu or from shortcut button.



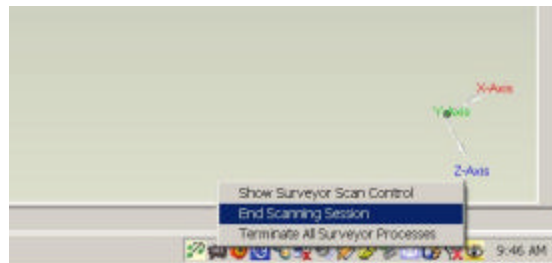
2. The Surveyor Hardware Plug-in dialog will open.



3. Click the Laser Capture button to open the Laser Scanning dialog.
4. Select the desired units.
5. Select the Geomagic tree object to store the data in.
6. Select your scanning options
 - a. Automatic Resize will auto zoom the Geomagic view to fit the data during scanning.
 - b. Virtual Camera will rotate the view to match the laser's Z direction relative to the part during scanning. So moving the arm will rotate the view on the screen.
 - c. Highlight Scan Pass automatically highlights the current scan pass.
7. Click the Start Capture button to begin scanning.
8. Use the front arm button to toggle scanning on and off.
9. SSC now has control of the PC, so all other Geomagic commands will be disabled.

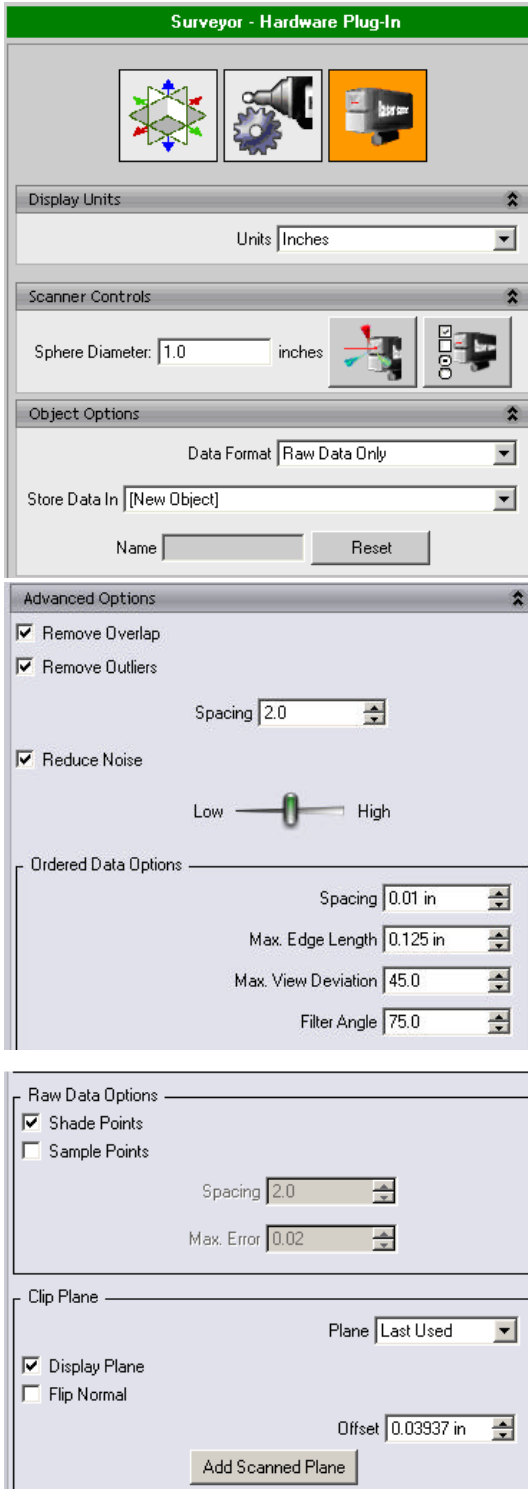


10. When you are done scanning you must end the scanning session to give control back to Geomagic. To do this right click the Surveyor Icon in the Windows system Tray, and select End Scanning Session.



11. Alternatively, you can program the back button of the arm to perform this function as well.
 - a. In the Surveyor Configuration Program, open the Settings for manual Motion Control.
 - b. Go to the Encoder Latching tab, and click the settings button.
 - c. Set the Back Button to End Scanning Session.
 - d. Once this has been setup, you can use the Back button to End Scanning Session inside Geomagic.

Default Scan Settings for Geomagic Laser Plug-in



Select Hard Probe or Laser Probe

Select Units for recording and display

If you are completing a laser alignment you should set the correct Sphere Diameter.

Data format should always be set to 'Raw Data Only'

You can define a group and name if desired. This can be changed later if needed.

You can have Geomagic Remove Overlap in scan data if desired by enabling check box. (Or just use 3D proximity filter on LDI toolbar.)

You can have Geomagic Remove Outliers in scan data if desired by enabling check box. (Or just use 2D outlier filter within scan parameters.)

You can have Geomagic Reduce Noise in scan data if desired by enabling check box. (Typically use on lowest setting or complete noise reduction post scan.)

Ordered data options should not be used and will be grayed out when 'Raw Data Only' is selected.

You can have Geomagic shade scan data if desired by enabling check box.

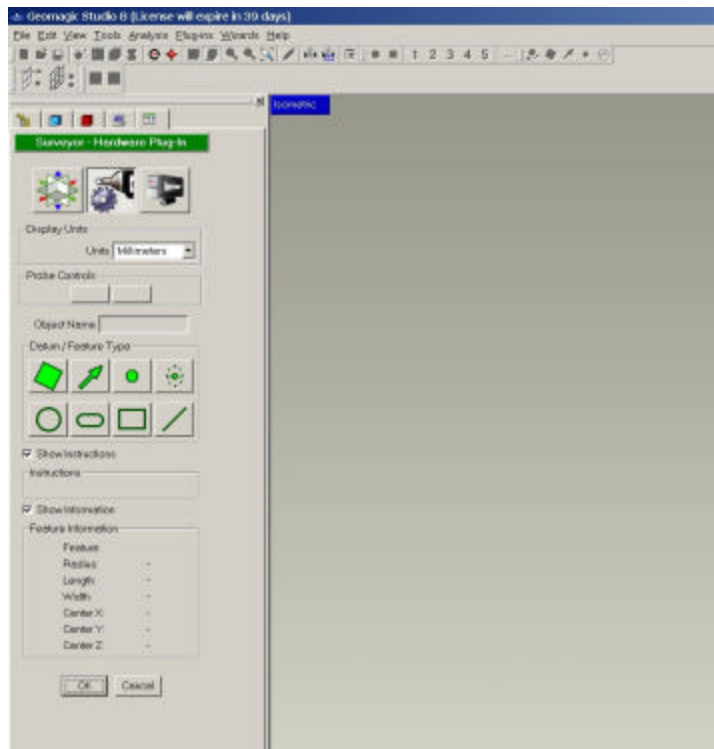
You can have Geomagic Sample Points in scan data if desired by enabling check box. (Or just use 3D proximity filter on LDI toolbar.)

You can have Geomagic Filter scan data with a clipping plan if desired by enabling check box. (Or just use 3D plane filter on LDI toolbar.)

Using the Hard Probe in Geomagic

When you launch the Surveyor Hardware Plug-in you also have the option of using the hard probe attached to your arm to collect data. Geomagic allows you to collect data using the touch probe as though you are using the arm's native software. When collecting data, Geomagic groups the data collected to form any number of Datum or Feature objects that Geomagic supports.

1. With the Surveyor Hardware Plug-in open, click the Hard probe Features and Datums button. The Hard Probe dialog will open.
2. Select the datum or feature type you wish to collect data for. You can collect data for the following types:
 - a. Datum Plane
 - b. Datum Axis
 - c. Datum Point
 - d. Datum Point Target
 - e. Feature Hole
 - f. Feature Slot
 - g. Feature Rectangle
 - h. Feature Line



3. If you leave the Show Instructions box checked, Geomagic will show you instructions for the data collection process. Follow these instructions for each datum or feature type.
4. Use the Front button on the arm to collect points.

When you are completed with the datum or feature measurement, you must End Scanning session. Either do so using the SSC System Tray icon, or by using the arm's Back button if it is programmed. See below for complete hardprobe instructions.

Detailed Hard Probe Data Collection Instructions:

Plane Instructions

1. Define a plane by probing 3 or more points on the surface of the object selecting "Start/Stop Scan Recording Mode". To complete the process, define the offset direction by probing a single point above the plane selecting "End the current Scanning Session".
2. Continue this process to define multiple planes. When finished, select "End the current Scanning Session" to return to the dialog.

Axis Cylinder Instructions

1. Define a cylinder by probing 6 or more points on the surface of the object selecting "Start/Stop Scan Recording Mode". To complete the process, define the axial direction by probing a single point above or below the cylinder selecting "End the current Scanning Session".
2. Continue this process to define multiple axes. When finished, select "End the current Scanning Session" to return to the dialog.

Axis Cone Instructions

1. Define a cone by probing 6 or more points on the surface of the object selecting "Start/Stop Scan Recording Mode". To complete the process, define the axial direction by probing a single point above or below the cone selecting "End the current Scanning Session".
2. Continue this process to define multiple axes. When finished, select "End the current Scanning Session" to return to the dialog.

Point Sphere Instructions

1. Define a sphere by probing 4 or more points on the surface of the object selecting "Start/Stop Scan Recording Mode". To complete the process, probe a single point inside or outside of the sphere selecting "End the current Scanning Session".
2. Continue this process to define multiple points. When finished, select "End the current Scanning Session" to return to the dialog.

Point Centroid Instructions

1. Define a local group of 3 or more points on the surface of the object selecting "Start/Stop Scan Recording Mode". To complete the process, define the offset direction by probing a single point above the group of points selecting "End the current Scanning Session".
2. Continue this process to define multiple points. When finished, select "End the current Scanning Session" to return to the dialog.

Circle Instructions

1. Define a plane by probing 3 or more points on the surface of the object selecting "Start/Stop Scan Recording Mode". To complete the process, define the offset direction by probing a single point above the plane selecting "End the current Scanning Session".
2. Define 3 or more points on the cylindrical wall perpendicular to the plane selecting "Start/Stop Scan Recording Mode". To complete the process, define the offset direction by probing a single point inside (hole) or outside (protrusion) of the circle selecting "End the current Scanning Session".
3. Continue this process to define multiple circles. When finished, select "End the current Scanning Session" to return to the dialog.

Slot Instructions

1. Define a plane by probing 3 or more points on the surface of the object selecting "Start/Stop Scan Recording Mode". To complete the process, define the offset direction by probing a single point above the plane selecting "End the current Scanning Session".
2. Define 3 or more points on the cylindrical wall of one end of the slot perpendicular to the plane selecting "Start/Stop Scan Recording Mode". Define the offset direction by probing a single point inside (hole) or outside (protrusion) of the slot selecting "End the current Scanning Session. Repeat this process to define the opposite end of the slot.
3. Continue this process to define multiple slots. When finished, select "End the current Scanning Session" to return to the dialog.

Rectangle Instructions

1. Define a plane by probing 3 or more points on the surface of the object selecting "Start/Stop Scan Recording Mode". To complete the process, define the offset direction by probing a single point above the plane selecting "End the current Scanning Session".
2. Define 3 or more points along each of the 4 rectangular walls perpendicular to the plane selecting "Start/Stop Scan Recording Mode". Define the offset direction by probing a single point away from one of the rectangle walls selecting "End the current Scanning Session".
3. Continue this process to define multiple rectangles. When finished, select "End the current Scanning Session" to return to the dialog.

Line Instructions

1. Define a plane by probing 3 or more points on the surface of the object selecting "Start/Stop Scan Recording Mode". To complete the process, define the offset direction by probing a single point above the plane selecting "End the current Scanning Session".
2. Define 3 or more points on a rectangular wall perpendicular to the plane selecting "Start/Stop Scan Recording Mode". Define the offset direction by probing a single point away from the wall selecting "End the current Scanning Session".
3. Continue this process to define multiple lines. When finished, select "End the current Scanning Session" to return to the dialog.

Surface Point Instructions

1. Define a plane by probing 3 or more points on the surface of the object selecting "Start/Stop Scan Recording Mode". To complete the process, define the offset direction by probing a single point above the group of points selecting "End the current Scanning Session".
2. Define the point by probing one point on the surface of the object selecting "Start/Stop Scan Recording Mode". To complete the process, select "End the current Scanning Session".
3. Continue this process to define multiple points. When finished, select "End the current Scanning Session" to return to the dialog.

Point Point Instructions

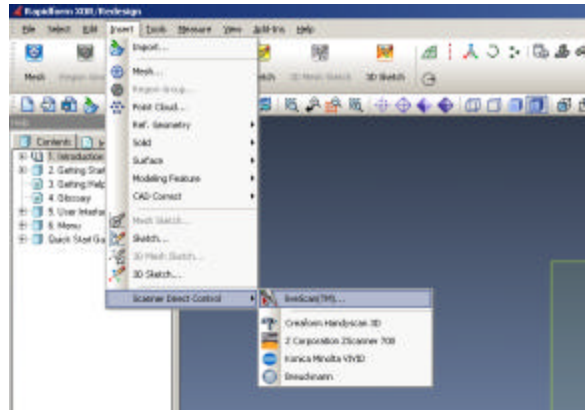
1. Define the point by collecting one point selecting "Start/Stop Scan Recording Mode". To complete the process, select "End the current Scanning Session".
2. Continue this process to define multiple points. When finished, select "End the current Scanning Session" to return to the dialog.

Rapidform liveScan™ (BETA)

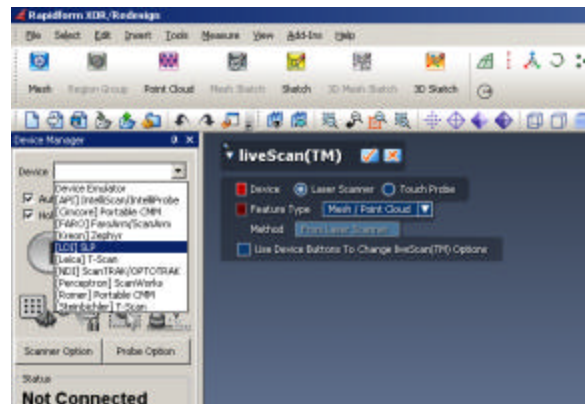
SSC comes with a software plug-in that allows you to scan from within Rapidform XOR directly. When using this plug-in, SSC will run in the background to collect data that is rendered inside Rapidform. In addition, the plug-in allows you to use some of the touch probe capability of your arm, so that you can combine scan data with touch probe data.

Laser Plug-in Instructions

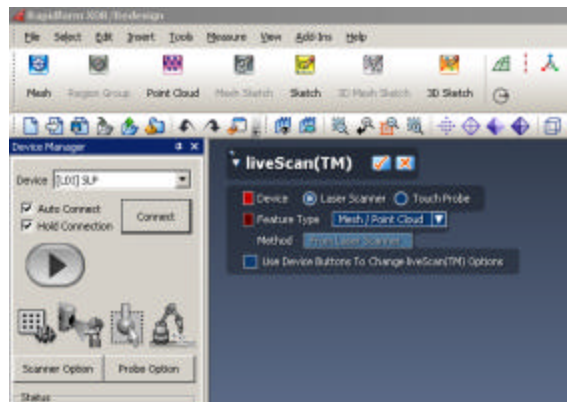
1. Start XOR.
2. Start Plug-in: Insert->Scanner Direct Control-> liveScan™



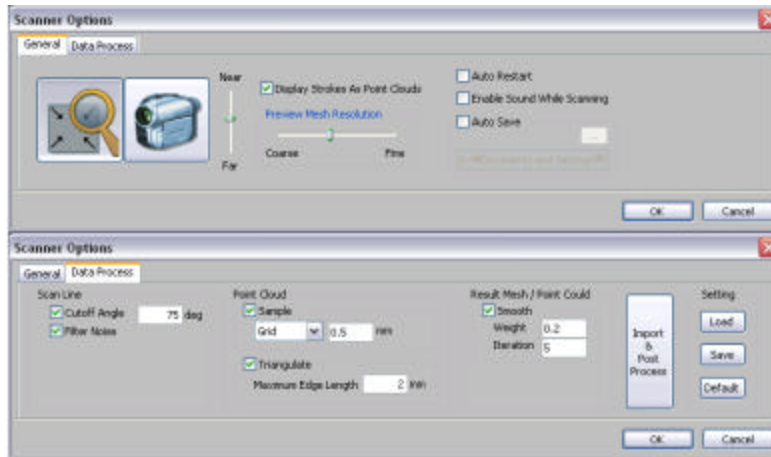
3. Select LDI (SLP) from Device drop down menu



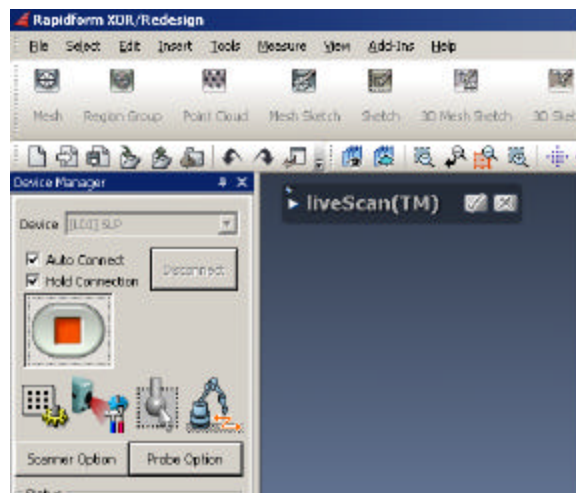
4. Click the Connect button



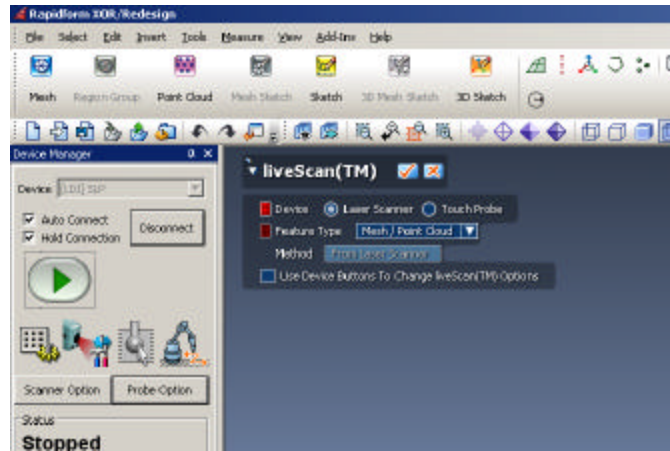
5. Set Scanner Options. (Suggested settings yet to be determined.)



6. Click Green Play button to start using
7. Calibrate system if needed, otherwise skip to step **XXXXX**. Start with Hard Probe Calibration in Predefined Scan Parameter toolbar and proceed with Laser Alignment. Through calibrate button.
8. See previous section instructions for completing hard probe alignment. Aligning the System->Hard Probe Alignment.
9. See previous section instructions for completing laser probe alignment. Aligning the System->Laser Probe Alignment. There are three differences that you will need to adjust the process for.
 - a. First you will need to click the calibrate button to being the laser alignment process. This will open a new window which will supply an interface for completing the data collection.
 - b. In this new window press 'Start Scan' and scan your first sphere as normal.
 - c. Once completed, Click the 'Stop Scan' button.
 - d. Repeat the process at least two more times to collect sphere data a minimum three times.
 - e. Once you are done, click the 'Calculations' button to perform calculations.
 - f. If the results are within specifications, you can click ok and close. If they are not within specifications, repeat process.
10. Complete your scan project. You may want to adjust your 3D proximity filter and scan parameters if required for your part.
11. Click Stop button



12. Click Disconnect button.



13. Click ok in liveScan™ Ok box and begin Mesh Buildup Wizard.

Hard Probe Instructions

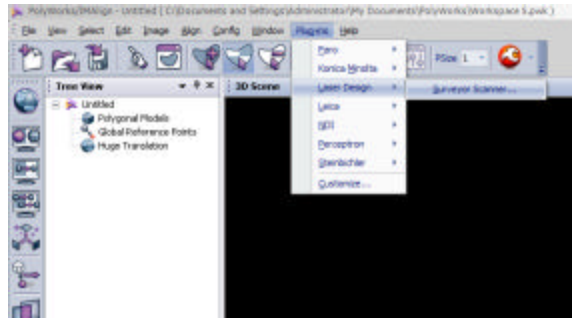
1. ***IN-PROCESS***

Polyworks IMAAlign Plug-in (BETA)

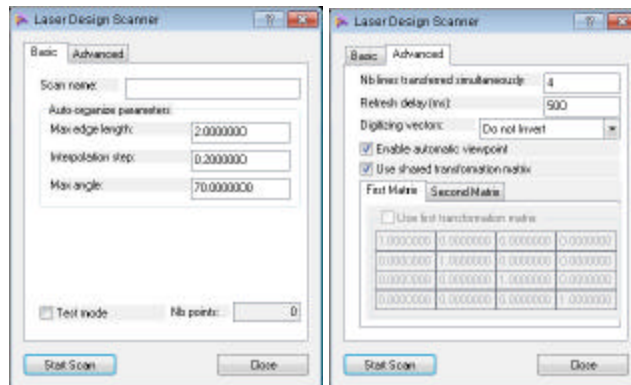
SSC comes with a software plug-in that allows you to scan from within Polyworks directly. When using this plug-in, SSC will run in the background to collect data that is rendered inside Rapidform. In addition, the plug-in allows you to use some of the touch probe capability of your arm, so that you can combine scan data with touch probe data.

Laser Plug-in Instructions

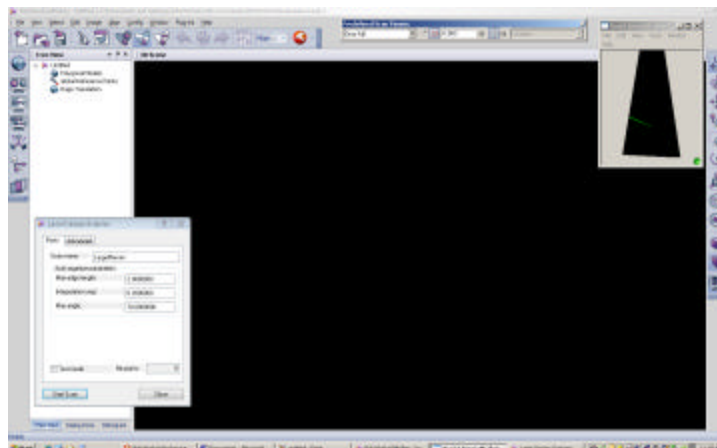
1. Complete the hard probe alignment and Laser Calibration inside of Surveyor Scan Control (SSC) if required before starting Polyworks. (Currently there is no laser alignment function within Polyworks.)
2. Polyworks IMAAlign
3. From the Plug-ins Menu Select Laser Design-> Surveyor Scanner...



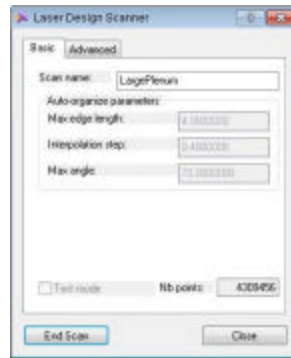
4. Once the hardware connects, you will get a Polyworks Scan Window. Set your data collection settings for file name, Max Edge length (2-4), Interpolation step (.2-.4), max angle (70-80), NB of lines transferred simultaneously (4-8), Refresh delay (250-1000), and leave the remaining settings as defaults.



5. Press the Start Scan button to begin scanning. It is recommended to take a single scan pass over the part for each 'record' session. If you collect too much data in a single record session you will get an 'Out of Memory' error from Polyworks.



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- When you have completed scanning click the End Scan button to close the plug-in and begin data processing. The LDI hardware connection will be closed once you close IMAAlign.



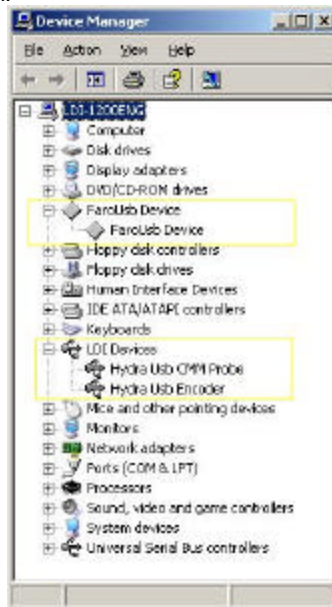
Troubleshooting- Known Issues

Occasionally problems will arise after the release of a software or hardware. Although LDI makes every attempt to eliminate and minimize these issues, due to system improvement, some of these issues will arise. Below you will find a list of known issues with their work-around and/or fixes.

- If you are experiencing system instability your current PC may not be able to handle system resource load of full speed scanning. First try closing other applications running. If problem persists, add the following registry key to limit SLP scanning rate. (DWORD MinSyncInterval)
 - HKEY_LOCAL_MACHINE\SOFTWARE\LASERVIEW\SURVEYOR\Line Scanning\34033f96-3f45-4a9f-9b9a-f332b584c4f3\MinSyncInterval
 - Modify binary setting to some number between 5 and 60, 5 being fastest scanning. Adjust until system performance is stable.

NOTE: Newer versions of SSC have multiple registry entries for multiple settings. You may need to enter HKEY_LOCAL_MACHINE\SOFTWARE\LASERVIEW\SURVEYOR\Configurations and locate the correct registry location by checking the Configuration Name setting to add the correct registry key.

- Surveyor Scan Control is having problems starting up or collecting data
 - Check device manager to make sure all your devices are installed properly. It should resemble below for a Faro Arm system.



- Verify all USB connections are running all USB cables (arm, trigger, and SLP probe) run through the USB HUB provided in the Power Supply/USB Repeater.
- Occasionally you may need to reset the hardware. If you reset the PS/USB Hub (gray box), you maybe required to unplug and replug in or hit the reset the box using the reset button to all the PC to see all USB devices plugged into hub.
- Check trigger cable for rigid connection between Faro arm and trigger box.
- Surveyor Scan Control is not collecting accurate-good data.
 - Check to make sure Arm is mounting rigidly with no movement. See arm manufacturer's instructions for setup and testing instructions.
 - Verify that arm as been 'initialized' (all joints have been put through their complete rotation)
 - Verify that probe and probe mount are both rigidly mounted to arm
 - Verify all USB connections are running all USB cables (arm, trigger, and SLP probe) run through the USB HUB provided in the Power Supply/USB Repeater.
 - Check probe alignment. When was the last probe alignment that you have completed? If it has been a while or you have bumped the probe or probe mount complete a new probe alignment.
 - Check your exposure and Noise Squelch settings. Verify that they are appropriate for the scanned surface.
 - Do you have the 3D proximity filter turned on?
 - Are you using the arm at or near its limits? Any stress on arm components will cause inaccuracies. There is a built in auto sensing function to not allow data collection when there is stress placed on the rotating joints, but there the software is unable to tell if any of the body tubes are under any stress. Be careful not to allow any force to be exerted on these tubes.
 - Complete a hard probe calibration in Faro Utilities or Geomagic plug-in.

-
- You are noticing performance issues with your system. IE: the data is collected sporadically. Check your system resources; make sure that you have enough free memory (RAM). System performance is directly related to how much data you are collecting. For optimal performance, collect only the data you need. Running 3d proximity filters (In-line or post scan) is recommended to keep file sizes small while still obtaining the point spacing you desire.
 - Windows 2000/XP/2003 will continuously search for a network connection if you are not connected. This is known to cause dramatic system performance issues. LDI recommends that if you are having problems with performance, once you start SSC (SSC requires a NICID when it initializes) you disable your unused network connections. Another easy work around is to plug you PC into a generic HUB (under \$20 and very small) as a simple work around.
 - 'Core' experiences errors and must shut down. This is commonly due to that detachment of the SLP laser probe while running. To reinitialize: shutdown SSC (wait for all SSC processes to end or force close), reattached SLP laser probe, and restart SSC.
 - System can not find SLP laser probe. You will get an error message when trying to start SSC (No CMM Probe Device Attached) and if you go to the Hardware Manager you will not see CMM Probe listed under Imaging Devices. This is commonly due to restarting the PC without cycling power on the SLP probe power Supply/USB Repeater. There is a known design flaw which causes the system to only recognize the USB Repeater and not the laser probe. To reinitialize, unplug the USB to PC connection from the USB Repeater. This will allow the PC to see the probe as a reconnected device and you can continue with your work.
 - Unusual or unexplained system performance. If you are experiencing random, unusual, and/or unexplained issues with your system, it is recommended to complete power down the system (and all components) and re-initialize them all. If you are still experiencing issues, please request LDI support as instructed in the main troubleshooting section.
 - Display is flickering while collecting recording. This is a graphics card setting issue. There is typically a setting in the advance display settings of the graphics card which needs to be changed. Typically it is referenced as Z-block transfer or force swap copy.

PC Maintenance

LDI recommends keeping your PC in an optimal performance level. This includes basic PC maintenance as listed below:
General Maintenance:

- Clean dust and debris from both PC case, monitor, keyboard, and mouse using compressed air, alcohol, or vacuum.
- Run Windows Operating system updates
- Run Microsoft Office updates
- Run Norton Anti-virus (or other) updates
- Run any 3rd Party Firewall updates
- Removing old scan files (deleting or backing up on CD/DVD media or server)
- Running Windows PC Maintenance
 - Disk Cleanup
 - Disk Defragmenter

System Backup:

- Export and save SSC registry
- Running 3rd Party backup software such as Norton Ghost or Windows Backup


System Debugging:

When you run into issues with systems and require support from Laser Design Support Engineers, it is best to provide as much information as possible. This will facilitate the process and allow for a quick solution of system issues. Below you will find a list of requested items as well as how to provide them.

NOTE:

- Each time you start an LDI program it creates new trace files to record what is happening. Depending on the level set in Surveyor Configuration more or less information will be recorded. It is very important to use the level 'Debug' and to reproduce the problem as simply as possible and to end the software session as soon as possible for LDI Tech Support to assist as efficiently as possible.



- LDI now places an icon () in the system tray when any Surveyor Process is running. It can be used to terminate all processes if required by right clicking on it.
1. Description of problem:
 - a. Include as many details as possible regarding the cause, work-arounds, frequency, start time, background information, etc....
 2. SSC Registry Settings:
 - a. From Surveyor Configuration:
 - i. Click on the registry tab
 - ii. Click on 'Export Registry'
 - iii. Select file name and save location.
 1. It is recommended to use a file name with meaning.
 2. Example LDI-1-1-2004.txt
 3. Surveyor Trace Files:
 - a. Systems are typically setup with minimum tracing enabled and should be turned on to 'Debug Mode' to provide as much information as possible.
 - i. Open Surveyor Configuration
 - ii. Click on the 'Tracing Tab'
 - iii. Click on the first pull down menu for the tracing level and select 'Debug'
 - iv. Click on the 'Set All Button' for the level settings
 - v. Change file locations and file size limits using the same procedure above if desired.
 - b. Once you trace files have been properly set, reproduce the problem using the simplest process possible.
 - i. It is recommended to use SMC for motion control issues and SSC for all other issues.
 - ii. It is recommended to shut down SSC or SMC, delete all existing trace files, and start a new SSC session.
 - iii. Reproduce the problem in the fewest steps.
 - iv. Record the time the problem occurs if possible
 - v. Shutdown SSC or SMC as soon as possible
 - vi. Before restarting SMC or SSC it is recommended to add all new trace files to a ZIP file so that they will not be lost if you restart SSC or SMC.
 4. Once you have collected the above files, please add them all to one zip file for easy transfer. If a particular data file and/or path plan helped you reproduce this problem, please also include these files in the zip file. You can email anything under 5MB, otherwise email tech@laserdesign.com and someone will instruct you with how to upload them to our website.
 - a. File List:
 - i. Registry Settings
 - ii. Trace Files
 - iii. Problem Description
 - iv. *.SSC data file
 - v. *.ppl path plan file
 5. LDI Technical Support Contact Information:
 - a. P: 952-884-9648
 - b. Email: tech@laserdesign.com
 - c. On-line Help: <http://www.laserdesign.com> -> Contact Us page-> Bottom of the page Online Support Button.