LMI TECHNOLOGIES

GoPxL Migration Guide

Migrating from Gocator 6.x or earlier to GoPxL 1.1

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1 Migration Basics

1.1 Naming

In this document, older versions of the Gocator software (6.x and earlier) are referred to as “Gocator 6.x”. In Gocator 6.x, Gocator sensors used “Gocator” firmware. There was no distinction between the hardware and firmware names. Separate names were used for the Emulator and Accelerator Windows PC applications.

With GoPxL, the software has a distinct name “GoPxL”. This is used for both the firmware which can be applied to Gocator sensors, and the software that can run on PC.

1.2 Upgrading sensor firmware from Gocator 6.x

Upgrading from Gocator 6.x firmware builds such as 6.3 or earlier to GoPxL is supported.

You can also downgrade sensors back to Gocator 6.x firmware after having upgraded to GoPxL.

It is recommended to first perform a backup of the sensor before upgrading to GoPxL. Job files from 6.x are preserved in storage though they are not visible in GoPxL after the upgrade. After downgrading back to 6.x firmware, they are still available. However other sensor settings on the Manage page that are *not* part of the job configuration will get reset through the upgrade.

Refer to the release notes for the supported Gocator models.

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1.3 Using existing recorded data

The scan data in Gocator 6.x .rec files can be loaded into GoPxL. Scan data from Gocator support (.gs) files can also be imported by first saving a .rec recording in Gocator 6.x, and then importing that .rec file into GoPxL.

Some limitations apply to loading .rec files:

- Video mode recordings can not be loaded.
- Opposite layout recordings with Top and Bottom data are not supported in GoPxL 1.1.
- It is not possible to import existing job files. Job files need to be re-created.

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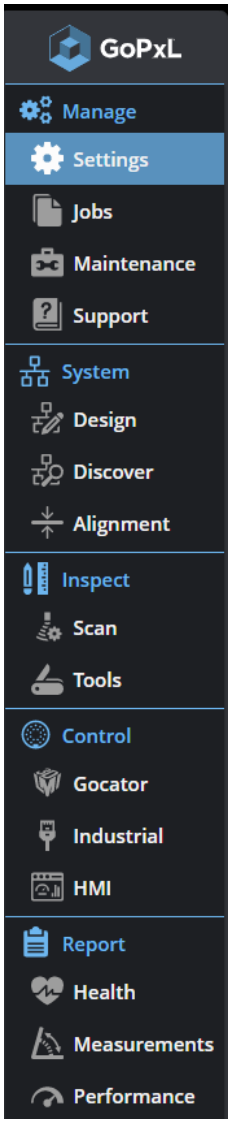
1.4 User Interface Overview

The sections of the UI have been renamed and regrouped.

Gocator 6.x firmware navigation bar	GoPxL 1.1 navigation bar
	

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Gocator 6.x name	GoPxL name	
Manage	Manage and System	The contents of the Manage page have been divided up between the Manage and System categories
Scan	Inspect > Scan	The Scan page is now under the Inspect category
Model	Inspect	Part matching and sectioning are moved to tools
Measure	Inspect > Tools	The tools are now under the Inspect category
Output	Control	Renamed
Dashboard	Report	Renamed

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2 Major Changes from Gocator 6.x

2.1 Sensor vs. Sensor Group

In GoPxL, a new term has been introduced: “sensor group”. A sensor group contains *one or more sensors of the same family* similar to the concept of a “buddy system” in Gocator 6.x. However internally, in GoPxL, every sensor is contained in a group. A group has an associated scan engine type (such as Gocator Laser Profile for G2 sensors). So for example, when you connect to a G2 sensor, it is already contained in a sensor group whose scan engine reflects the family of the sensors it contains. For information on how this impacts “buddying,” see 2.7 Buddying.

In development of GoPxL, the term “scanner” was used to refer to this group of sensors. The use of this term was later reduced in the UI but some occurrences may still be found in APIs and documentation.

2.2 Jobs

The job format is changed from .job to .gpjob. The two formats are not compatible.

After upgrading to GoPxL, the old Gocator 6.x jobs are not visible since they can not be loaded. But they will remain on the sensor and can be accessed again after downgrading back to Gocator 6.x.

In Gocator 6.x, jobs were created starting from the current configuration. A factory restore was necessary to clear the sensor configuration. With GoPxL it is possible to create new jobs starting from a clean/empty configuration. Just select New Job in the jobs dropdown or on the Jobs page.

2.3 Scan Page

Unlike Gocator 6.x Emulator, when loading a support file in GoPxL, the maximum frame rate is not calculated without a physical sensor present. So it is not possible to simulate maximum frame rate with different settings without a physical sensor. Use the 6.x Emulator to determine maximum frame rate.

Filters are not applied to the last scan data as they are in Gocator 6.x firmware. To see the effect of Filter changes, perform a new scan.

2.4 Model Page

The Model page is removed. The following features are replaced by tools.

- Part matching “Edge” - The “Edge” mode part matching functionality is replaced with the much more flexible and powerful “Surface Pattern Matching” tool. The tool allows output of
- Part matching “Bounding Box” - Use a combination of the Surface Bounding Box tool and Surface Transform tool.
- Part matching “Ellipse” - Use a combination of the Surface Ellipse tool and Surface Transform tool.
- Sectioning - Use the Surface Section tool.

2.5 File Formats / Extensions

The file formats in GoPxL are incompatible with their Gocator 6.x equivalents.

	GoPxL extension	**Gocator 6.x equivalent**	**Contents**	**Use cases**
Job	.gpjob	.job	• Scan settings • Tool settings • Control/output	Quickly change a set of settings by switching from one job to another
Recording	.gprec	.rec	• Current job settings (see above) • Recorded data Note, sensor settings are not necessarily visible after loading a recording.	Quickly save and load recorded data for development and diagnostic purposes.
Backup	.gpbak	.bak	• All jobs • Layout and transformation • Sensor settings • Current recorded data • Global settings	Allows restoring a sensor to a previous state in case undesired changes were made.

Support	.gpsup	.gs	• Everything the Backup file contains • Additional diagnostic information	For supporting development and diagnosing issues.

2.6 Emulator

The GoPxL Windows application can load recorded data from sensors similar to how the Gocator Gocator 6.x emulator allowed importing support files. Simply download a .gprec recording file from a sensor and load it into a GoPxL instance running on PC.

2.7 Buddying

GoPxL no longer uses the terms “Buddy” and “Buddying” for grouping sensors together into a system, but the same functionality is maintained. In GoPxL, you group sensors in a “sensor group” to do this. The action of adding a second device to a group is equivalent to buddying the second sensor to the first one. For information on the sensor groups, see 2.1 Sensor vs. Sensor Group.

Currently, upgrading grouped sensors in one step is not possible. To upgrade a sensor group, you must ungroup them, upgrade them individually, and then group them again.

2.8 Acceleration

The GoPxL application can run either directly on a sensor, on a GoMax NX device, or on a PC. When GoPxL is running on a PC, we use the term “instance” for each running copy of GoPxL. Having sensors "accelerated" in GoPxL terms is simply "running GoPxL on GoMax” or “running GoPxL in a PC instance” and adding one or more sensors to the GoMax or PC.

Note that unlike Gocator 6.x firmware, the configuration from the sensor is not automatically synchronized between the sensor and PC. In GoPxL, the configuration of an accelerated sensor system, including jobs, is only maintained on the PC. See the below table for the changes to consider:

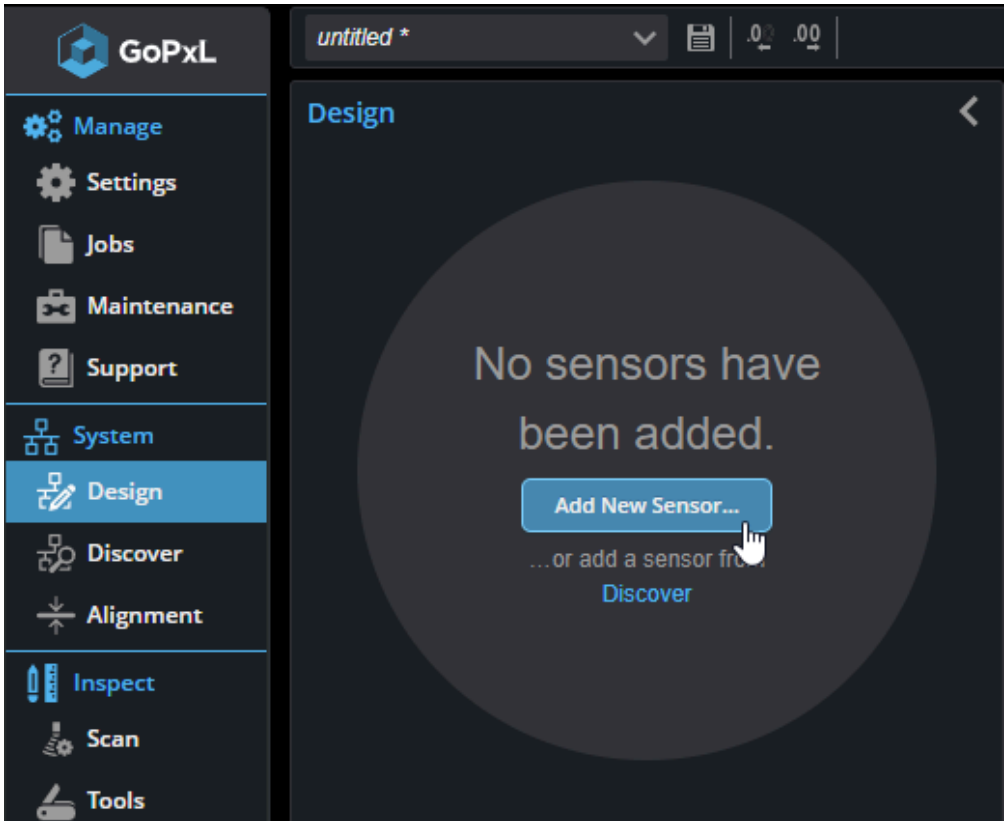
	Gocator 6.x	**GoPxL**

Accelerating a sensor	Current configuration and jobs from the sensor are available after accelerating.	Current configuration and jobs from the sensor are left on the sensor. The active configuration and jobs of GoPxL on PC are used to configure the sensor. A backup from the sensor can be restored on the PC to copy the active configuration and jobs.
Removing an accelerated sensor from the PC	Current configuration and jobs of the accelerated sensor are available on the un-accelerated sensor.	The active configuration and jobs remain on the PC and can be used with the same sensor again when available or with another sensor. To transfer settings to a sensor, obtain a backup from the PC and restore it on the sensor.
Replacing a sensor	A backup of the old sensor must be restored on the replacement sensor.	Remove the old sensor from the configuration and add the new one. All configuration is maintained on the PC.
Replacing the PC	Remove the sensor from the old PC and accelerate it with the new PC.	A backup of the old GoPxL instance must be restored on the replacement PC.

To accelerate a sensor with GoPxL, follow these steps:

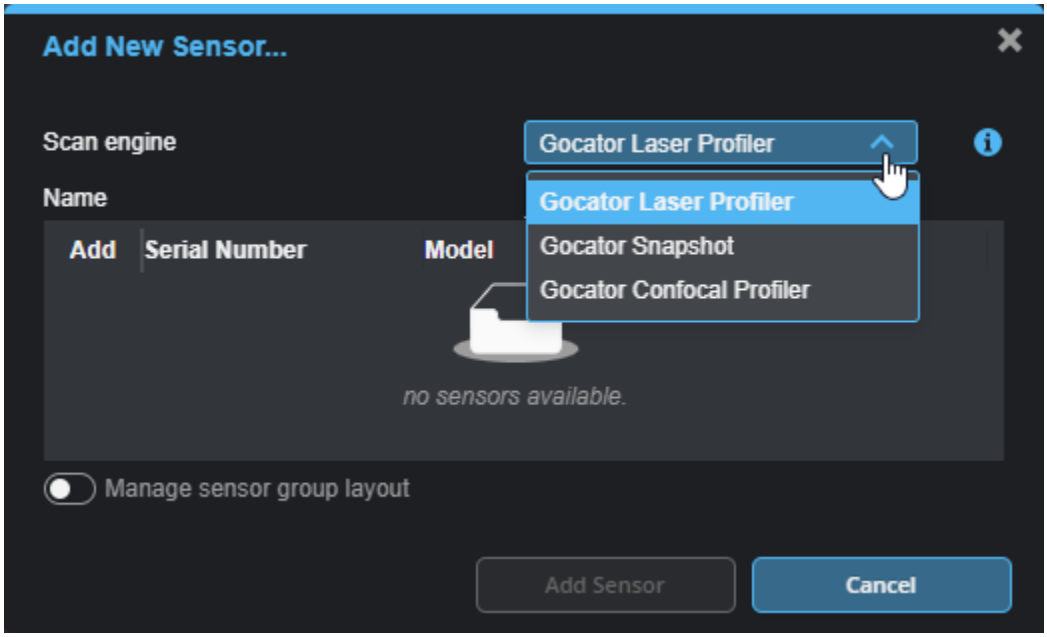
1. Download a GoPxL Windows version that matches the version of your sensor.
   The GoPxL software is available in the GoPxL Utilities package.
2. Unzip the package and in the GoPxL folder, double-click the *GoPxL x64* shortcut.
   The GoPxL interface of the PC instance launches in your browser.
   You may need to allow the PC instance through your firewall.

3. In the GoPxL interface on your PC, go to the System > Design page

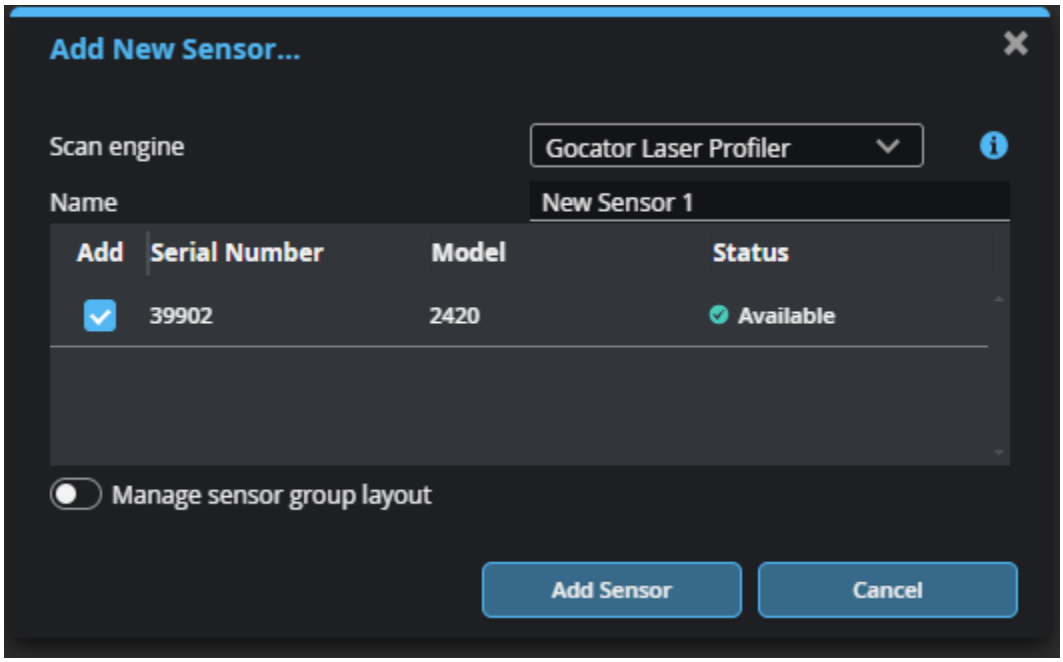


4. Click **Add New Sensor…** (see above).

5. Select the scan engine if necessary.



6. Select the sensor you want to accelerate, and click **Add Sensor**.



After these steps the selected sensor is accelerated by your PC. GoPxL on PC will attempt to stay connected to this sensor as long as it is part of the configuration.

2.9 Industrial Protocols

There are several differences as compared to Gocator 6.x:

- Alignment: Whereas in Gocator 6.x, the Stationary and Moving alignments have two separate commands, in GoPxL, there is one single command to perform an alignment. The command performs either of the Stationary or Moving alignments based on the configuration set in the job.
- Runtime variables: Currently (as of GoPxL 1.1) there is no support for runtime variables.

2.9.1 Gocator Protocol

- Unlike Gocator 6.x, the Gocator protocol in GoPxL is not enabled by default.
- All outputs need to be manually added in GoPxL. In Gocator 6.x, Surface or Profile data is enabled by default.
- Gocator 6.x outputs measurements and data while playing back in replay mode only in the Emulator. GoPxL outputs measurements and data in replay mode also on Sensor, PC, and GoMax.

2.9.2 Ethernet ASCII

- The “loadjob” command requires that the “.job” extension is NOT included
- Using the “loadjob” command with no parameter no longer returns the currently loaded job.
- “value” and “decision” commands now require one or more measurement IDs.
- “setvar” / “getvar” writing and reading runtime variables are not supported.

2.9.3 PROFINET

- Alignment: Legacy alignment mode is not supported in GoPxL. All fields are 32-bit aligned.
- Support on PROFINET: GoPxL supports PROFINET on GoMax NX devices. However, PROFINET support is not currently available for the PC.
- Decision output: GoPxL 1.1 does not support the output of “decisions”.

2.9.4 EtherNet/IP

- Connections Map: In Gocator 6.x, command output is combined with system state. In GoPxL, the command output and system state are separated. Also, sensor Group (aka Scanner) states are available in all the GoPxL industrial protocols.
- Decision output: GoPxL 1.1 does not support the output of “decisions”.

2.10 SDK

2.10.1 General

The Gocator 6.x SDK obtains the full configuration of the sensor when connecting and maintains a copy of the configuration. When a configuration change is made from the SDK the entire configuration is sent to the sensor. This means that changes from another client such as the Web UI are overwritten by the SDK when new changes are applied from an SDK application.

With GoPxL, the SDK does *not* obtain or maintain a full copy of the sensor configuration, so changes from another client are not overwritten when making changes from the SDK.

Gocator 6.x SDK performed discovery of sensors automatically in the background as part of GoSystem construction. With GoPxL, discovery is not automatically enabled, but sensors can be connected to by IP address, or discovery can be manually enabled.

2.10.2 Tool configuration

Measurement tools are now all based on the GDK framework. Previously, in the Gocator 6.x SDK, legacy tools were managed through GoTools subclasses, and newer GDK based tools were managed through GoExtTool. In GoPxL, all tools can be configured through a single consistent method.

2.10.3 Intensity output

If intensity is enabled it is automatically included in the output. Intensity data is included in the surface and profile messages.

2.10.4 Alignment

Although alignment can be performed, alignment configuration from the SDK is not currently possible. To perform alignment, the SDK relies on the alignment configurations that are set in GoPxL and are stored in a job. The SDK can be used to switch between different jobs with different alignment configurations.

2.10.5 Channels

In Gocator 6.x protocol, Control, Data, Health, Discovery and Upgrade functionality is separated into different Channels.

The Control channel in Gocator is changed to a REST-like protocol. This channel contains the information which in Gocator 6.x was available via a stand-alone Health channel. This information is now referred to as “metrics” in GoPxL. The other additional features in the Control channel include asynchronous notification and data streaming. The other two channels, i.e., Discovery and Upgrade remain the same.

Discovery is no longer treated as a critical component, instead of requiring a device to be discovered for connection, the user can supply an IP address to connect to.

2.10.6 .NET SDK

The .NET SDK is now a standalone SDK with no dependency on the C SDK allowing for more portability.

2.11 Motion and Alignment

Alignment is now performed through a wizard-like routine. Note that alignment tools are also provided, but LMI suggests using these tools for debug purposes only.

The routines ask you to pick a sensor group and an alignment method and will perform the alignment, similar to the way it was in Gocator 6.x. If additional information is required (e.g., hole sizes / distances / etc), they will be presented as parameters in the routine.

In case of alignment issues, a user can instantiate the needed method's tool in the "Inspect" page, work with it as any other tool and see its 6DOF outputs, as well as the speed and encoder calibration results if those are available. Running the tool will **not** automatically fill the alignment values into the transformation page.

2.11.1 Alignment reference

There is no longer a switch between "Dynamic" (per-job settings) and "Fixed" (global settings). Only "Fixed" Alignment Reference is supported where motion and alignment settings are shared across all job files.

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3 Other Changes

3.1 Arrays

GoPxL supports the multi-layer output of G5 sensors through the new Array tools. Currently, two tools are available: Array Index and Array Create.

Only Array Index is currently fully supported. You use the Array Index tool to extract a single profile, at the user-provided index value, from the multi-layer data. The profile at that index is available as an output from the Array Index tool. You can then use that output as input for any Profile tool.

G5 output > Array Index profile output > Profile tool input

Note that you need to add an instance of the Array Index tool for each layer.

3.2 Recording / Replay

When loading a recording, the first frame is displayed. In Gocator 6.x, the last frame was displayed.

In Gocator 6.x, changes to configuration on the Scan page would typically result in the replay buffer being cleared. In GoPxL, the replay buffer is not cleared automatically when making changes. Instead, the user is only prevented from continuing recording under some conditions.

For many changes to the configuration, recording can be continued after applying the change. But for change involving the outputs from the scan engine, it is not possible to resume recording.

3.3 Top & Bottom

In Gocator 6.x, a buddy system with sensors configured in opposing layout would produce Top & Bottom. The Top and Bottom data was included within the data stream for profiles and surfaces. Users could specify with tool parameters whether to operate on Top, Bottom, or Top&Bottom data combined.

With GoPxL the concept of Top and Bottom data within a single stream is removed. Top and Bottom data can be routed into tools either as independent inputs or through an array.

3.4 Scan mode impact on tools

In Gocator 6.x, switching between scan modes Video, Profile and Surface could hide existing tools in a job configuration. This could become confusing especially when the hidden tools caused the sensor not to start. In GoPxL, tools added to a job remain visible when switching modes.

3.5 Exposure time units

Due to sensor architecture in Gocator 6.x, exposure values provided by the user in the interface are divided by a factor of 1.024 internally. So for example, setting an exposure value of 1000 µs results in the sensor using a 977 µs exposure internally.

In GoPxL, the units for exposure match the actual exposure time.

4 Sensor-specific changes

4.1 G3 snapshot sensors

The Pattern Index order has been reversed. For example, 1 is 13 and 2 is 12. This change was made to match the order of the projections in time.

5 Measurement Tool Changes

5.1 Measurement Regions

Center-based positions

Rectangular region coordinates in GoPxL are now center-based rather than corner-based. When manually entering the coordinates of a region, you will specify the X, Y and Z coordinates of the *center point* rather than the coordinates of the *top-left corner* for Surfaces, or *bottom-left corner* for Profiles.

For example, these are the coordinate values of a matching region in Gocator 6.x and GoPxL:

Gocator 6.x	**GoPxL**
X: -3	Center X: 0
Y: -3	Center Y: 0
Z: 0	Center Z: 5
Width: 6	Width: 6
Length: 6	Length: 6
Height: 10	Height: 10

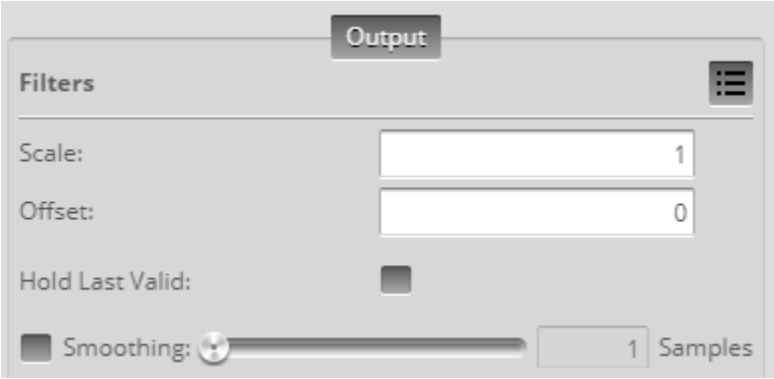
Angle anchoring

In Gocator 6.x, when the user configures a Z Angle anchor but does not configure both X and Y anchor sources as well, changing the region position by entering a value for either the region X or Y position results in horizontal and vertical shifts respectively. The same applies for 2D profile regions (with X and Z position and Y angle).

In GoPxL, when the user configures only a Z Angle anchor but does not configure X and Y anchor sources as well, changing the value for either the X or Y region position results in a shift in the direction determined by the current Z Angle anchor input. The same applies for 2D profile regions (with X and Z position and Y angle).

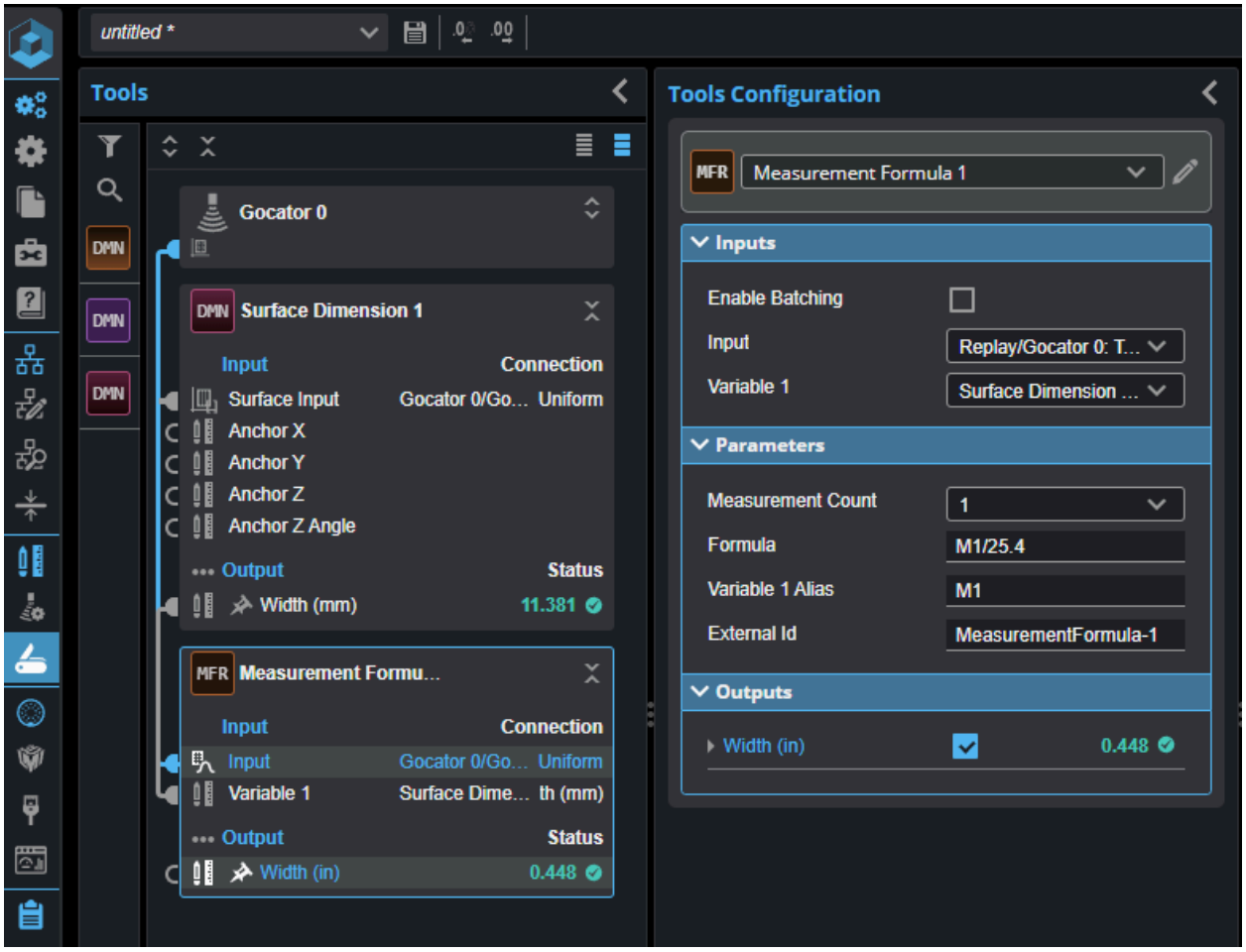
5.2 Measurement Filters (Scale, Offset…)

Measurement filters including Scale, Offset, Hold Last Valid and Smoothing are not available in GoPxL.



Scale and offset adjustments can be applied using both the Script tool and the Measurement Formula tool. Here is an image demonstrating the use of the Measurement Formula tool for this

purpose:



In this example, a Measurement Formula tool is used to convert a width measurement from a Surface Dimension tool from millimeter units to inches by using the formula "M1/25.4".

5.3 Profile Advanced Height

- Height measurements are now output as an array.
- Provides more file-related operations compared to the version in Gocator 6.x.
- Removes various “Edit {SOMETHING} Region” checkboxes. Simply expand the related region sections to edit.
- If a measurement is invalid, its associated graphics will not be displayed, while in Gocator 6.x, the graphics are displayed whether the measurement is valid or not.

5.4 Profile Bounding Box

- Profile Bounding Box and Profile Bounding Box Advanced are merged into a single tool
    - Global measurements removed
    - Supports rotation.
- Supports both uniform (resampled) data and point cloud ("raw") data for input profile.

5.5 Profile Bridge Value

- Different results may occur when Region is disabled because GoPxL takes all valid points into consideration.

5.6 Profile Circle

- ‘Profile Circle’ and ‘Profile Circle Advanced’ merged into a single tool.
    - A new parameter called **Fitting Method**, with Iterative Robust Least Squares and RANSAC as options, and other parameters related to each method.
    - Outlier Fraction parameter.
- Circle geometric feature output has been added.

5.7 Profile Circle Radii

- The tool can now output radius and diameter arrays (when **Enable Array Output** is checked). When array output is not enabled, the tool is limited to a minimum step of 20 degrees.

5.8 Profile Closed Area

- In GoPxL, the minimums of the two parameters **Max Gap** and **Sample Spacing** are set to 0. (There was no minimum limit in Gocator 6.x.)
- The GoPxL version uses only the Contour method (which uses an algorithm based on Green's theorem) of Profile Bounding Box Advanced. Previously, it used the Sector method of the advanced version of the tool. The new method is more accurate with profiles that include concave areas.

- Because of this, the **Center Selection** and **Sample Spacing** parameters have been removed. (These were needed by the Sector method that the non-Advanced tool in Gocator 6.x used.)

5.9 Profile Filter

- 'Profile Filter' adds the standard preprocessing filters in Gocator 6.x 'Scan' page, and also supports Gaussian filters. The filter type list is 'Gap Filling', 'Median', 'Averaging', 'Decimation' and 'Gaussian'.
- Only supports one type of filter for one tool instance in GoPxL, while it supports multiple filters in Gocator 6.x.
- All filters will process intensity/map data besides height data if it exists, while it only processes height data in Gocator 6.x.
- 'Gap Filling' and 'Gaussian' only support filtering along X. Others can support Y filtering which calculates multiple frames.
- 'Gaussian' only has a 'Sigma' parameter, and its kernel size is deduced according to the formula used in OpenCV internally, which is 'sigma = 0.3*((window-1)*0.5 - 1) + 0.8'.
- Processing Time measurement removed.

5.10 Profile Groove

- In GoPxL, the tool only returns measurements for the groove defined by the tool's parameters.
- To get measurements of multiple grooves, add the corresponding number of Profile Groove tools, set **Selection Type** to an "Index" option, and set the **Selection Index** of each tool instance to a different, 0-based value.

5.11 Profile Intersect

- "Angle Range" parameter switched from being a measurement parameter to being a tool parameter."

5.12 Profile Mask

- Now also supports Y angle anchoring.

5.13 Profile Panel

- Added two Point geometric features outputs: Left Gap and Right Gap.

5.14 Profile Part Detection

- The Profile Part Detection is primarily useful for diagnostic purposes. Also, this tool provides “Part” frame of reference, whereas continuous Surface generation does not.

5.15 Profile Position

- Supports both uniform and point cloud profile inputs.

5.16 Profile Round Corner

- Adds a Line geometric feature output.

5.17 Profile Strip

- In Gocator 6.x, you could add multiple measurements to return multiple measurements corresponding to different grooves visible in the region of interest. In GoPxL, the tool only returns measurements for the strip defined by the tool’s parameters.
- To get measurements of multiple strips, add the corresponding number of Profile Strip tools, set **Selection Type** to an “Index” option, and set the **Selection Index** of each tool instance to a different, 0-based value.
- Added measurements:
    - Count (total number of strips)
    - Three arrays, containing information on all strips, ordered from left to right:
        - Left edges
        - Right edges
        - Centers

5.18 Profile Thickness

- New tool.

5.19 Profile Transform

- GoPxL uses the line's position to calculate offsets, whereas Gocator 6.x only uses the angle of the line. If there is also a Point geometric feature input, offsets are adjusted based on the transformed coordinate system.
- Fixed transforms apply to the coordinate system, not to the data, unlike in Gocator 6.x.

5.20 Surface Align Ring

- Processing Time measurement removed.
- A new “Refresh” option is added to the drop-down menu “Operation.”
- X Offset, X Field of View, and X Start are no longer needed in GoPxL.
- When setting up a system you intend to align using Surface Align Ring, in the **System** > **Design** page, add *all* sensors to the "Top" row. After, leave them in that layout: The configuration file used by Surface Mesh applies the necessary transformations.

5.21 Surface Align Wide

- Processing Time measurement removed.
- A new “Refresh” option is added to the drop-down menu “Operation”

5.22 Surface Ball Bar

- Processing Time measurement removed.
- Output order is adjusted to group results from each ball.

5.23 Surface Bounding Box

- "Global" measurements removed.

- **Show Corners** parameter added. When enabled, a Point geometric feature is output for each corner (Corners {n}).

5.24 Surface Blob

- **Use Intensity** parameter is always shown, even if the input has no intensity.
- Diagnostic Surface is the result after filters are applied.

5.25 Surface Ball Bar

- The order of parameters is improved compared to the Gocator 6.x version.
- The order of the outputs is also adjusted.

5.26 Surface Circular Edge

- Added an **Edge Detection Mode** parameter, with two options: "Step" and "Corner."

5.27 Surface Cylinder

- Processing Time measurement removed.
- Due to improvements to the internal algorithm for checking outliers, results with "Auto. Detection" search mode may differ slightly when compared to Gocator 6.x. Results are identical for the other search modes.

5.28 Surface Circular Edge

- Adds two Point geometric feature outputs: Min Error Point and Max Error Point, representing the points of minimum and maximum error furthest inside and outside of the circle.

5.29 Surface Curvature Correction

- Tool renamed from "Surface Curvature."
- Processing Time measurement removed.
- The **Number of Regions** parameter defaults to "Not Used".

- Polynomial order is from 1 to 8, whereas in Gocator 6.x, it is from 0 to 8.
- Sampling step in GoPxL includes one more option: "32".

5.30 Surface Direction Filter

- In Gocator 6.x, you could configure the filtering parameters separately for multiple regions. In GoPxL, you set the parameters for the tool and they apply to all regions. To apply different filtering to different regions, you can chain multiple instances of the tool.
- The flexible mask in the GoPxL version of the tool, unlike in Gocator 6.x, not only decides which points to pass to the filtering, but also removes the unfiltered ones completely from the final surface. Two parameters—**Mask Mode** and **Preserve Data Outside Region**—work together to produce different results.
- **Min / Max *Azimuth* Angle** parameters: Renamed to remove “azimuth.”

5.31 Surface Edge

- Omits the advanced function of replacing invalid edge points with the nearest valid Z value.

5.32 Surface Ellipse

- Surface Ellipse and Surface Ellipse Advanced merged into a single tool, applying the interface of the legacy version and omitting bounding box relevant outputs of the advanced version.

5.33 Surface Extend

- In GoPxL, the minimum limit of the parameter **Overlap Length** has been set to 0. (There was no minimum limit in Gocator 6.x.)

5.34 Surface Filter

- Only one filter per tool instance.
- Only four "standard" filters (Gap Filling, Median, Averaging, Decimation) are displayed when **Show Advanced Filters** is disabled; these correspond to the filters available on

the Scan page in Gocator 6.x. The remainder ("advanced" filters") are available when **Show Advanced Filters** is enabled.

- Standard filters have separate checkboxes to enable/disable filtering along X/Y dimension as in Gocator 6.x 'Scan' page, and also support units in mm/pts as other advanced filters (0 equivalent to no filtering). They process height map and intensity map simultaneously (if available) by default as in Gocator 6.x. Also provides a 'Preserve Data Outside Region' checkbox for standard filters except 'Decimation' filter.
- Advanced filters can process height/intensity maps by unchecking/checking 'Use intensity', and keep the other one unchanged. They produce same results as their counterparts in 'Surface Filter' tool of Gocator 6.x, except the following differences:
    - Gaussian filter in GoPxL uses 'Sigma' instead of 'Kernel Size' in Gocator 6.x, which will be converted to kernel size internally based on the formula: sigma = 0.3*((KernelSize-1)*0.5 - 1) + 0.8.
    - Relative Threshold filter uses a flexible reference region instead of rectangle in Gocator 6.x.
    - Applies eroded mask to remove boundary artifacts for "Gaussian" and "Equalize" filters by default.
    - Supports both mm/pts units for Laplacian filter as other opencv-based filters
    - Can process an even kernel size input (adjusted to odd internally), unlike in Gocator 6.x.

5.35 Surface Flatness

- In Gocator 6.x, only 15 measurements were displayed, and the rest were in the generic output. In GoPxL, the maximum is now 64, and all are available in array outputs.
- Various Point geometric feature outputs have been added. These were previously only available in the tool's generic output in Gocator 6.x.
- Currently at least, the median Point outputs are present (but empty) even when **Enable Median Detection** is unchecked. These may be hidden in the future when median detection is disabled.

5.36 Surface Mask

- Now also supports point cloud input.

5.37 Surface Merge Wide

- The tool's **Processed Surface** output may be slightly different compared to Gocator 6.x.
- Removed Processing Time and Frame Index measurements.
- "Refresh" option added to the **Operation** drop-down.
- For Sensor parameters, **Rotation X/Y/Z {n}** has been renamed to **Angle X/Y/Z**.

5.38 Surface Mesh

- The tool's output Mesh may differ slightly compared to Gocator 6.x.
- Removed Processing Time measurement.
- "Refresh" option added to the **Operation** drop-down.

5.39 Surface Part Detection

- Use this tool to perform part detection on G3 sensors, or on G2 or G5 sensors when surface generation mode is not set to Continuous.

5.40 Surface Pattern Matching

- **Enable Array Output** parameter added. When this parameter is enabled, the tool outputs arrays instead of individual measurements and geometric features for each match.

5.41 Surface Position

- When **Feature** is set to Min Y, the tool picks the rightmost point in GoPxL.

5.42 Surface Roughness

- New tool.

5.43 Surface Section

- The **Averaging Width** parameter has been removed. Instead, the length of the region (along Y) is used as the averaging window, unless **Single Line** is enabled (see next).
- A **Single Line** parameter was added. When **Single Line** is enabled, the tool performs no averaging: only data points under the section are output.

5.44 Surface Segmentation

- "Segments Array" data output is removed.
- **Use Intensity** is always shown, even if there's no intensity.
- **Enable Array Output** parameter added. When this parameter is enabled, the tool outputs arrays instead of individual measurements and geometric features for each part.

5.45 Surface Sphere

- Compared to the tool in Gocator 6.x, the GoPxL version:
    - Supports flexible regions
    - Supports Anchor Z Angle
    - Adds an **Outlier Fraction** parameter.
- In Gocator 6.x, “Use Region” is enabled by default. In GoPxL it’s disabled by default to let the tool to initialize the flexible region size properly
- Results of the tool in GoPxL may be slightly different from those in Gocator 6.x because GoPxL strictly chooses the points inside or outside the ROIs, whereas Gocator 6.x uses a rounding strategy.
- In GoPxL, the tool only uses “Least Square”.

5.46 Surface Stitch

- The tool doesn’t support stitching scans from top and bottom.

5.47 Surface Stud

- Added shaft outputs:
    - Measurements: Shaft X, Shaft Y, Shaft Z
    - Feature: Shaft Point

- **Use Region** is disabled by default in GoPxL to let the tool first get the input stream to properly size the initial region.

5.48 Surface Track

- The "Output Measurement" and "Profiles List" data outputs have been removed.

5.49 Surface Transform

- Processing Time measurement removed.

5.50 Surface Vibration Correction

- The Processing Time measurement has been removed.
- The data output “Corrected Surface” has been renamed to “Processed Surface”.
- Anchors are not supported in the GoPxL version.

5.51 Surface Volume

- “Thickness Type” parameter switched from being a measurement parameter to being a tool parameter.

5.52 Feature Create

- The Feature Create tool is split into four simpler tools:
    - Feature Circle Create
        - Z Angle anchor input removed.
        - With the "Constant circle" or "Circle from points" output types, you can get a tilted 3D circle by unchecking **Project To 2D** and then setting the **Normal X**, **Normal Y**, and **Normal Z** parameters that are displayed with these types.
        - By default, the tool outputs the projected 2D circle as in Gocator 6.x based on the input type, that is, the circle is on the X-Z plane for Profile mode and on the X-Y plane for Surface mode.
    - Feature Line Create

        - For the “Projected line on plane” output type, the X/Y/Z measurements are the intersection point of the line and the plane, instead of the projected point of the arbitrary point on line to the plane.
    - Feature Plane Create
        - Added measurements:
            - Z Offset
            - Normal X / Normal Y / Normal Z
        - Removed Z Angle
        - Renamed Origin Distance measurement to Distance.
        - Outputs a valid XY plane by default when choosing “Constant plane” instead of the invalid output of Gocator 6.x.
    - Feature Point Create
        - The output type “Point from line and circle” no longer distinguishes between Profile and Surface modes, unifying the calculation in 3D (project line to the circle’s plane, then calculate intersections).

5.53 Feature Dimension

- The "Absolute" parameters are moved from under the measurements in Gocator 6.x to the main Parameters section in GoPxL.

5.54 Feature Intersect

- Added **Intersection Type** drop-down parameter to choose the type of intersection the tool calculates. This also changes the available inputs.
- Removed **Angle Range**, as users typically only care about the minimum intersection angle, which is 0-90 degrees
- For line-line type, the angle measurement output is Projected Angle when **Project To 2D** is enabled, to show that the angle is between the two projected lines instead of the original input lines.
- Added a Line geometric feature output. This output is very useful when you choose Plane and Plane for **Intersection Type**.
- For the line-line type, the input is Surface, the tool shows both the input lines (in cyan) and projected lines (in yellow). Gocator 6.x only shows projected lines.
- For the plane-plane type, the intersect line is displayed.

5.55 Feature Robot Pose

- Matrix output removed.
- Roll, Pitch, and Yaw measurements in Gocator 6.x renamed in GoPxL to X Angle, Y Angle, and Z Angle, respectively.

5.56 Measurement Formula

- New tool.

5.57 Mesh Bounding Box

- Removed the Processing Time measurement.
- Rotation X/Y/Z renamed to X/Y/Z Angle.

5.58 Mesh Plane

- **Plane Detection Mode** renamed to **Detection Mode**.
- Removed the **Eliminating outliers** option from the **Detection Mode** drop-down.
- In Gocator 6.x, **Search Direction** is always displayed. In GoPxL, **Search Direction** is only displayed when **Detection Mode** is one of the following options
    1. With Largest Area
    2. With Maximum Distance
    3. With Minimum Distance
- Removed the **Processing Time** measurement.

5.59 Mesh Projection

- The tool can now accept geometric feature outputs from the Feature Create tools and from other tools that produce these outputs, such as Surface Plane, Surface Edge, and so on, and not just Mesh tools.

5.60 Mesh Template Matching

- Added a **Use Coarse Matching** option.

5.61 Script Tool

- The Script tool executes a user-defined **Python-based** script. The tool supports all GoPxL data types as input and output including:
    - Surface and Profile data (including intensity)
    - Measurements (values and decisions, and anchor sources for other tools)
    - Geometric features
    - **Arrays** of the supported types

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