Geomagic Qualify 8
What's New Guide

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1 Overview

Geomagic Qualify 8 contains new general-purpose functions and advanced tools for the analysis of automotive sheet metal parts. Qualify 8 now supports the FARO Laser Tracker X.

One enhancement allows users to calculate wall thickness as well as perform a 3D comparison along any user-specified vector.

Sectioning can now be performed on partially selected geometry as well as on the total part.

A new tool will allow the user to manually manage correspondence, providing the ability to modify and manage the automatically calculated mapping between reference geometry and test geometry.

2 Automotive sheet metal functions (new)

Three new calculations are offered for typical sheet metal applications:

- Edge calculation between a measured part and a reference part. (See the new Edge Calculation function. )
- Gap & Flush comparison between a measured part and a virtual ring gage (checking fixture). (See the new Edge Calculation function. ).
- Gap & Flush comparison between two measured parts. See the new Gap & Flush function. ).

Results are displayed in various forms, depending on the type of analysis:

- Annotations
- Tables
- Whisker plots
- Ribbon plots

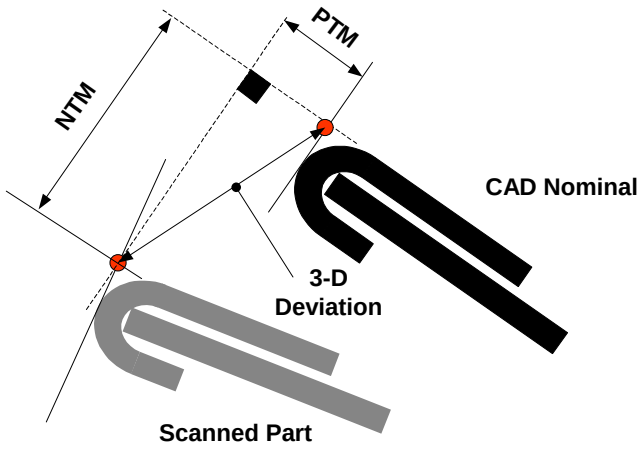
Qualify 8 now supports Line Scanner as the input device for these analyses. In the future, full scans will be supported.

2.1 Edge Calculation

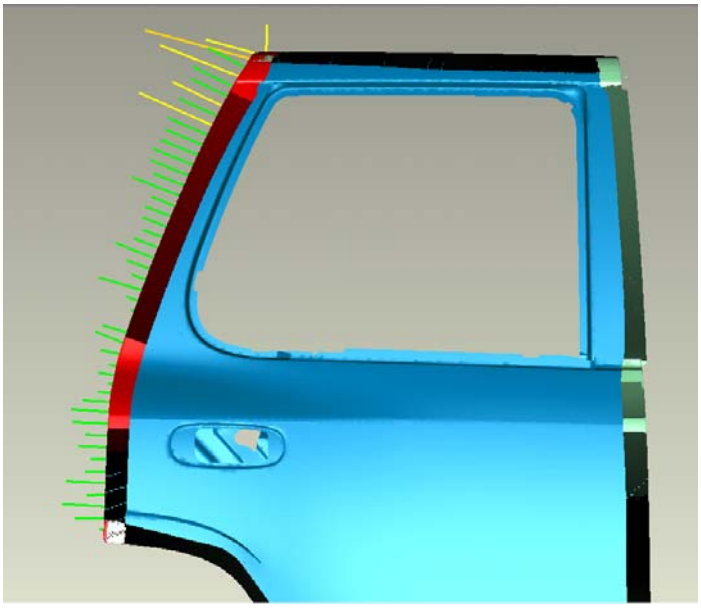
The Edge Calculation function  offers the ability to compare plain edges or hemmed edges between a Reference model and a Test model. Such parameters are known as PTM or Parallel-To-Metal and NTM or Normal-To-Metal. These parameters are relevant to the stamping or hemming process on sheet metal parts.

The meaning of PTM and NTM for a hemmed edge is explained in the following picture.

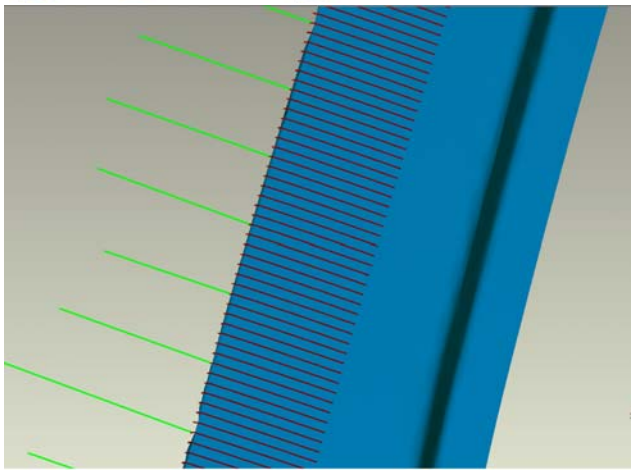
In case of a plain edge, the considered point for the calculation is the corner of the sheet metal.



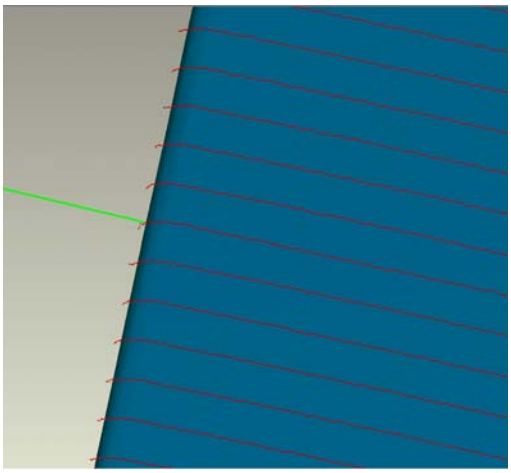
The user may also display the results in a qualitative way, by using a whisker plot or ribbon plot.



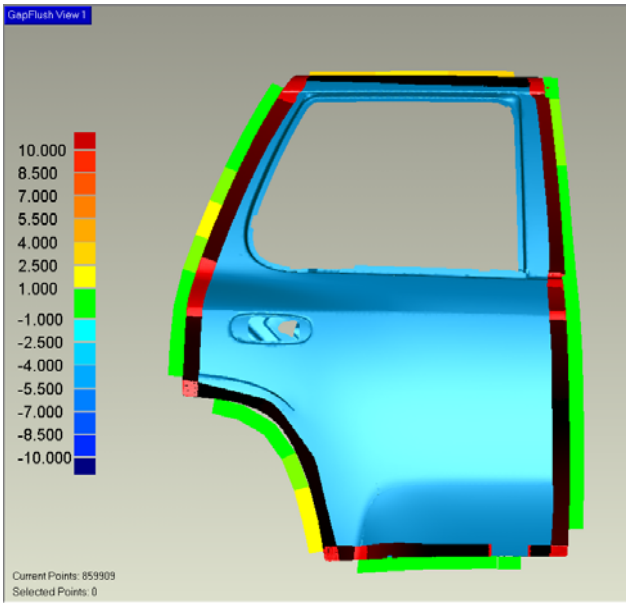
NTM analysis with whiskers



Zoom in on a Whisker Plot



Additional Zoom on a Whisker Plot

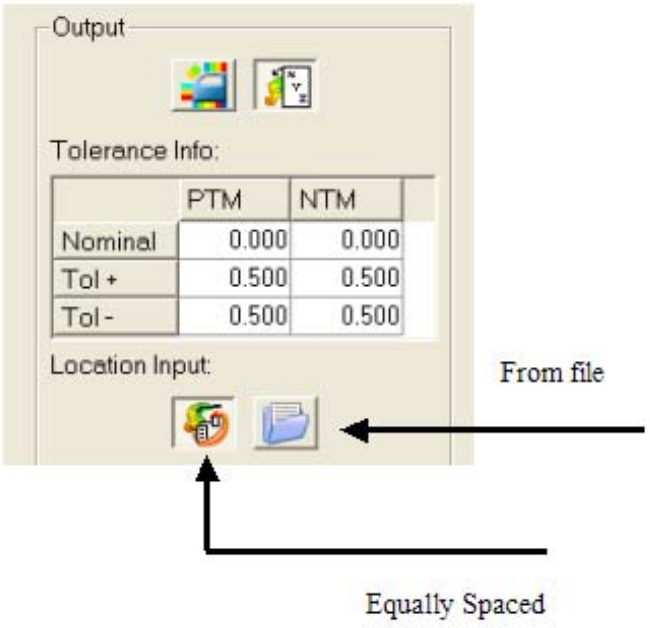


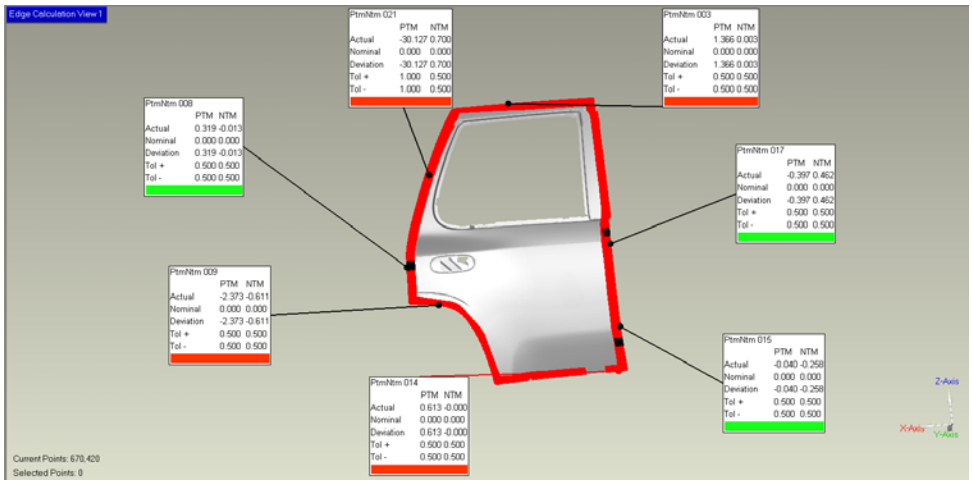
NTM Analysis with Ribbon Plot

Annotations can be added to a Whisker Plot and to a Ribbon Plot. The content of each annotation is configurable, to include the PTM results, the NTM results, and/or a pass/fail indicator.

The user has several methods of specifying the exact location(s) of analysis:

- Manual pick
- Automatically and Equally spaced (range is manually input)
- From file that specifies exact location (similar to a Location Set, but with a different format)





"Manual Pick" method of Specifying Analysis Locations. Click one location, or Shift-Click or Control-Click multiple locations.

Benefit to users of 3D scanners

Quantifiable benefits: *Previously, this calculation was performed by taking a manual 2D section and measuring the position of the test section versus the reference section. The user had to identify the area of calculation, make the section, rotate the section, create 2 dimensions (horizontal and vertical). Total time: 1 minute for each section.*
Considering a typical case of a door with 50 location, total time of 50 minutes.
With the new command, the task is reduced to a total of few seconds.
Total saving for each door study: about 49 minutes.
Non-quantifiable benefits: *the new calculation does not rely on a manual selection of the analysis locations, resulting in higher and more repeatable quality.*

Benefit to users of traditional techniques

Quantifiable benefits: *Typically, the measurement is performed by using a CMM (with a probe and shank technique) and then comparing the measured point with the CAD drawing. While the whole process of taking measurements is long (1 hour or more), the number of points collected is limited. Using a line scanner on a robot and Qualify analysis, such inspection and reporting is down to 4 minutes. Total saving for a door inspection: 1 hour per door.*
Non-quantifiable benefits: *With the scanning technique, the calculation of the PTM and NTM is based on more points, resulting in higher and more repeatable quality.*

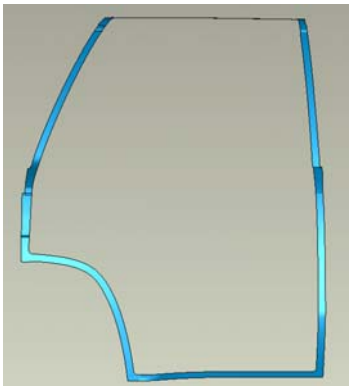
2.2 Virtual Gage

The virtual gage option provides the user the ability to calculate gap & flush of an actual part (i.e a measured door) versus a simulated (virtual) ring gage. This calculation replaces the manual process of physically loading a part such as a door on a calibrated and dedicated physical fixture (hard gage) and then having an operator using manual caliper to check the gap (or flush) between the door and the ring gage.

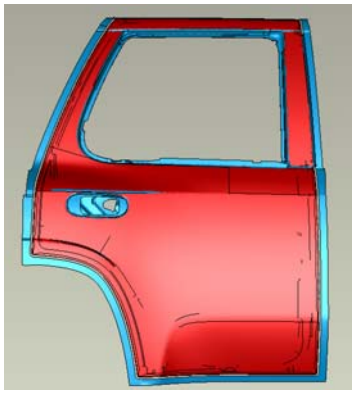
In this case, three different parts are in the Model Manager:

- A CAD model of the part (REF)
- Measured points or polygons (i.e. a collection of clusters) as TEST
- A Ring Gage (defined in the Gap & Flush menu as “other object”)

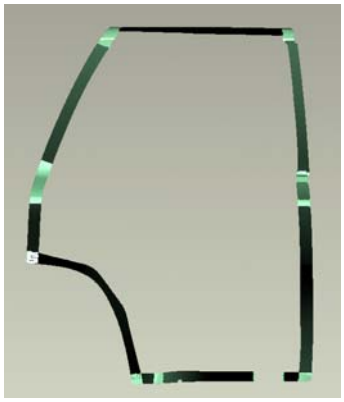
REF part



Ring Gage(other object)



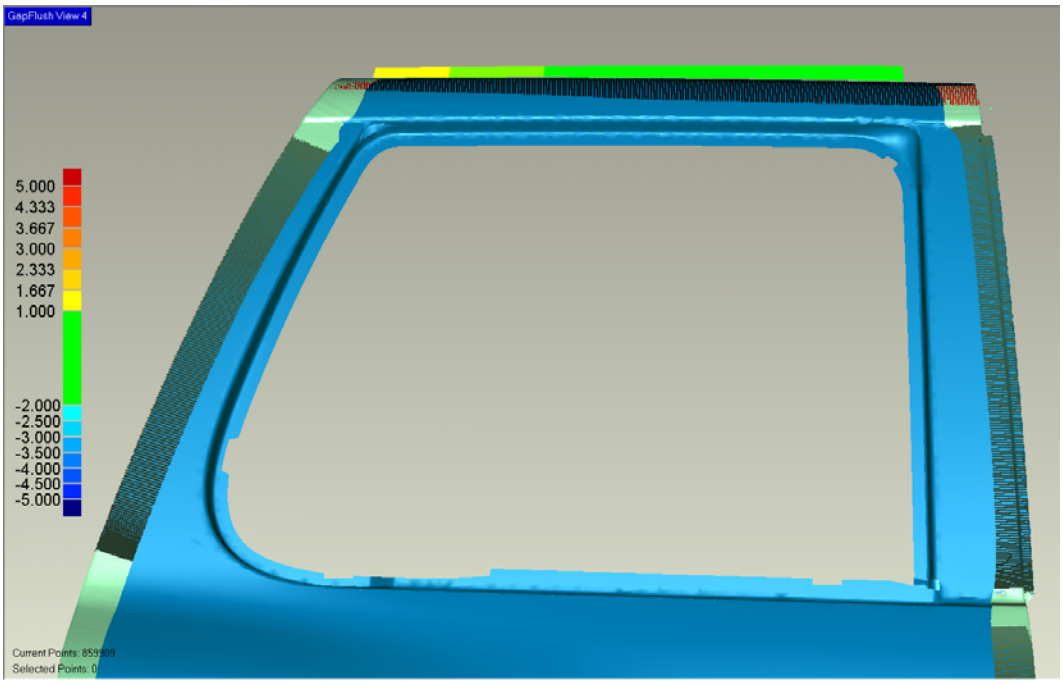
REF + Ring Gage



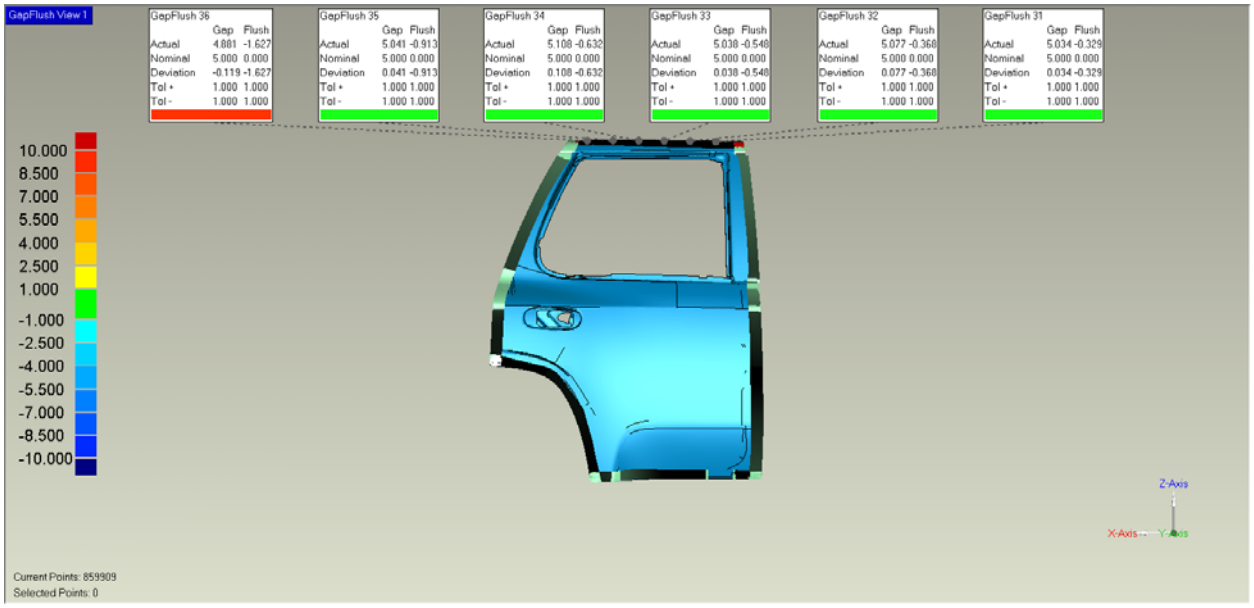
TEST

In this case three visualizations are available:

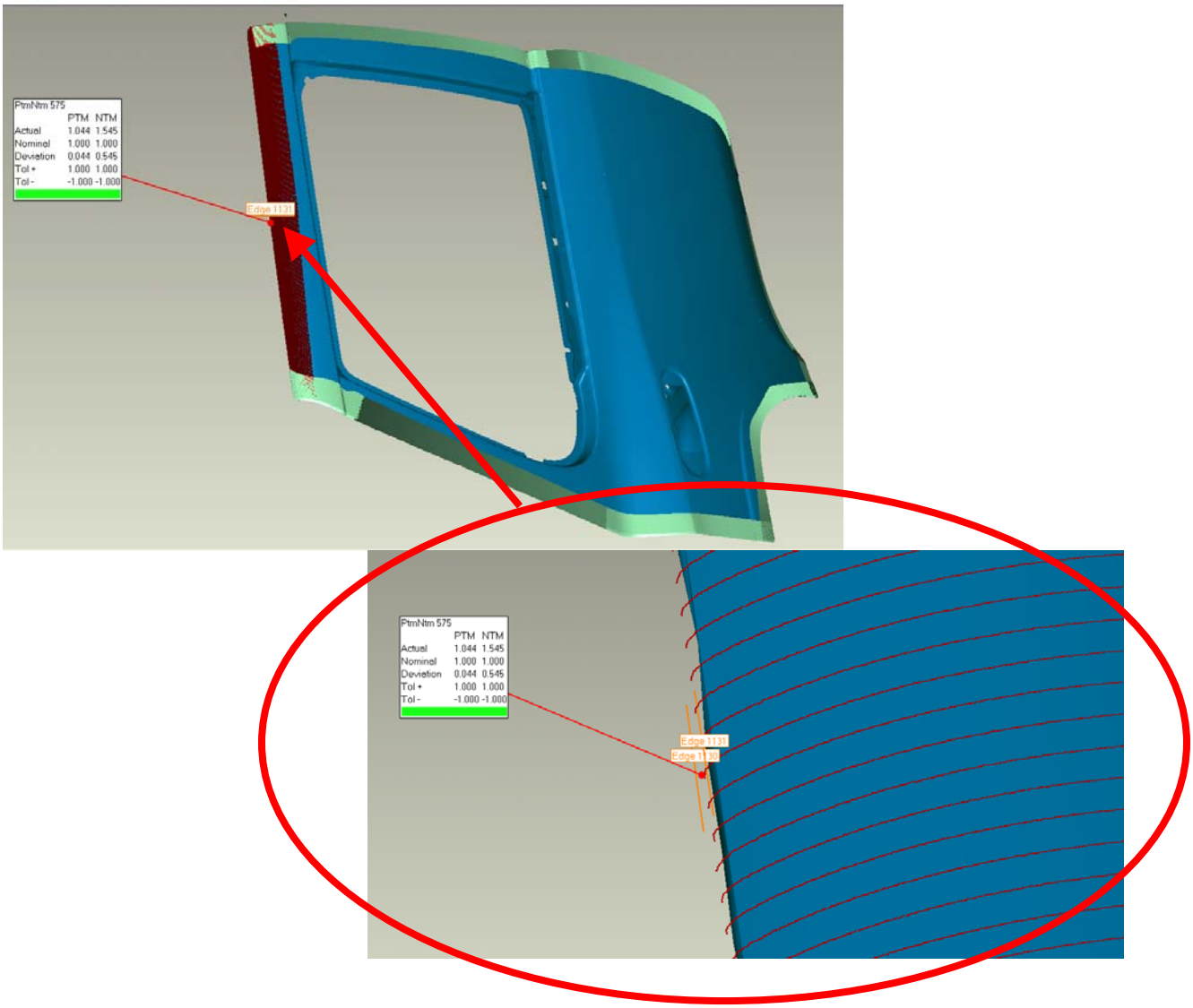
- Whiskers for a qualitative analysis
- Ribbon for a qualitative analysis
- Annotation for a quantitative analysis



Gap between door and ring gage, ribbon analysis



Gap between door and ring gage, annotations



Also in this case, the user has 3 options for specifying the location of the analysis:

- Manual pick
- Automatically spaced (range is manually input)
- From file (similar to a location set, but with different format)

Also in this case, the user can select the clusters the calculation is performed on.

Benefit to users of 3D scanners

Quantifiable benefits: *Previously, this calculation was performed by taking a manual 2D section and measuring the position of the test section versus the reference section. The user had to identify the area of calculation, make the section, rotate the section, create 2 dimensions (horizontal and vertical). Total time: 1 minute for each section.*
Considering a typical case of a door with 50 location, total time of 50 minutes.
With the new command, the task is reduced to a total time of few seconds.
Total saving for each door study: about 49 minutes.

Non-quantifiable benefits: *The new calculation does not rely on a manual selection of the points to be dimensioned, resulting in higher and more repeatable quality of the calculation.*

Benefit to users of traditional techniques

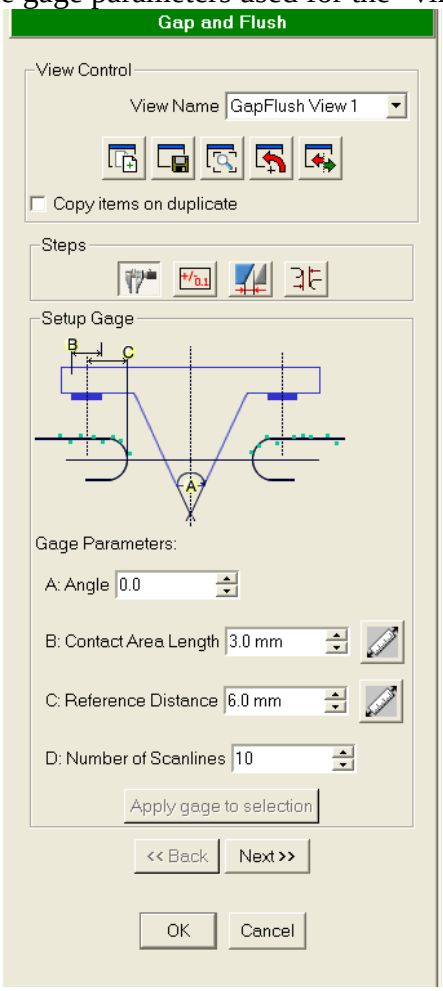
Quantifiable benefits: *Typically the measurement is performed by using a hard gage called ring gage. With traditional ring gauges, each new part requires a new gauge and checking fixture – which can costs upwards of $100,000. This is the cost for each part inspected!*
Considering a car, 4 doors, hood and trunk lid are inspected using the ring gage technique.
Total cost saving: 600K$ per car

Non-quantifiable benefits: *Gap & flush measurements are manually checked by the operator using manual tools. The process is fully dependent on the operator, his skill and his repeatability.*
This scanning technique results in a faster, higher quality, and more repeatable measurement.

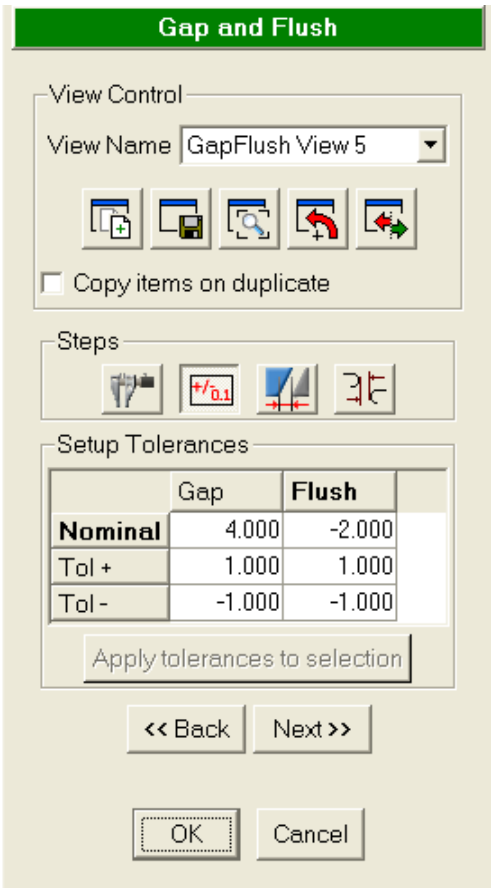
2.3 Gap & Flush

The Gap and Flush calculation,  , provides the ability to calculate gap & flush between two regions within a part.
The calculation emulates the physical operation of using a gap gage to verify the distance between two objects such as a gap between the Glove compartment and the Instrument Panel. This calculation replaces the current manual operations of creating sections within Qualify, in specific location and performing a 2D comparison.
Only one TEST part is required (scanned area all around the Glove Compartment inside the IP) to perform the analysis. There is no need of CAD REFerence part to perform the Gap and Flush Analysis

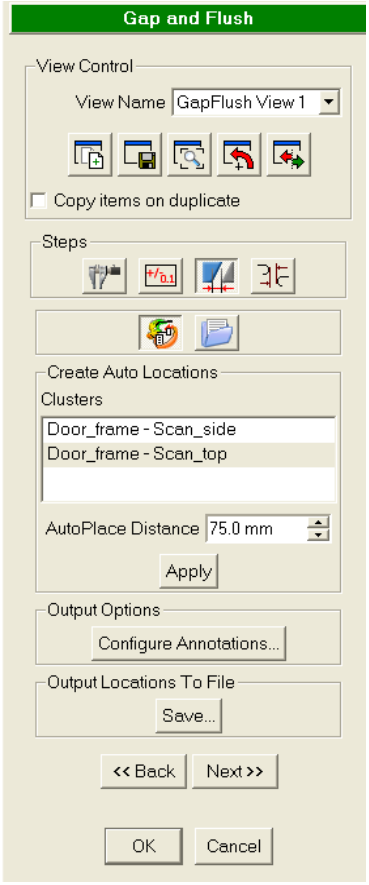
A wizard style menu helps the user to set the necessary parameters, perform the calculation and review the results.
The first step is about setting the gage parameters used for the “virtual” inspection”



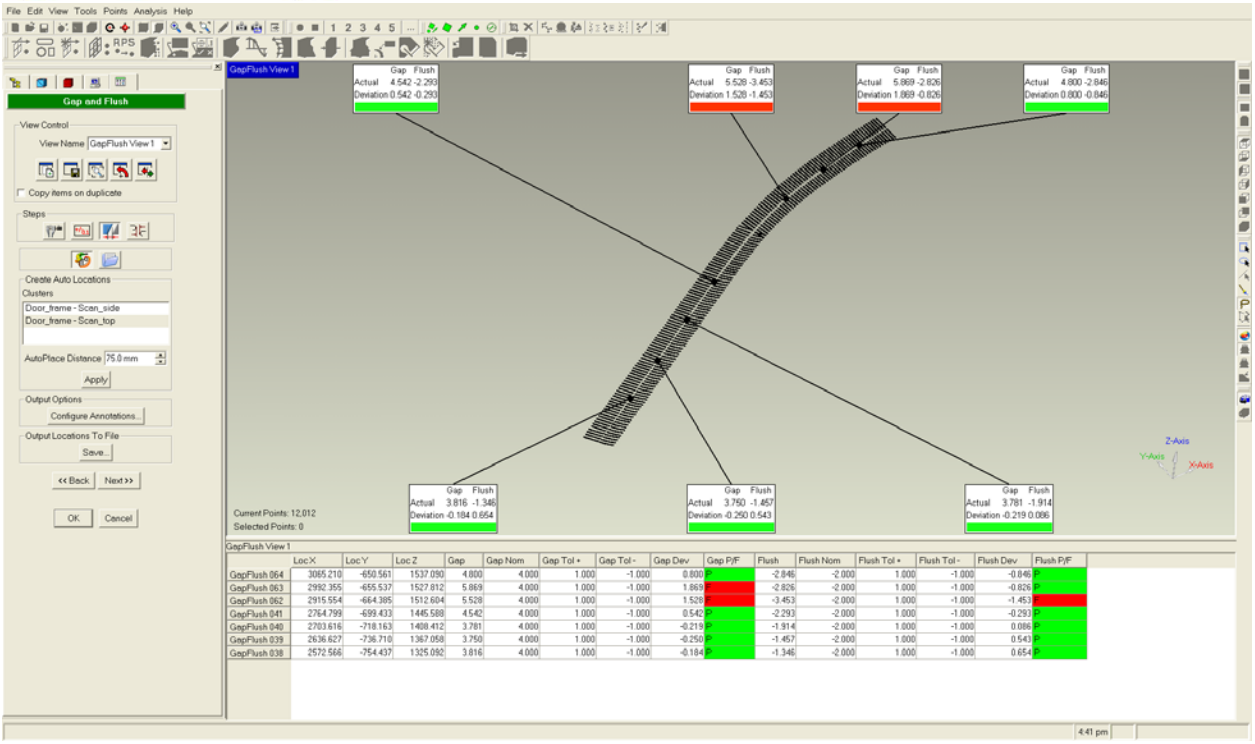
The second step allows the definition of the nominal values of the parameters and of the tolerances


Gap and Flush
View Control
View Name
GapFlush View 5
Copy items on duplicate
Steps
Setup Tolerances
Gap
Flush
Nominal
4.000
-2.000
Tol +
1.000
1.000
Tol -
-1.000
-1.000
Apply tolerances to selection
<< Back
Next >>
OK
Cancel

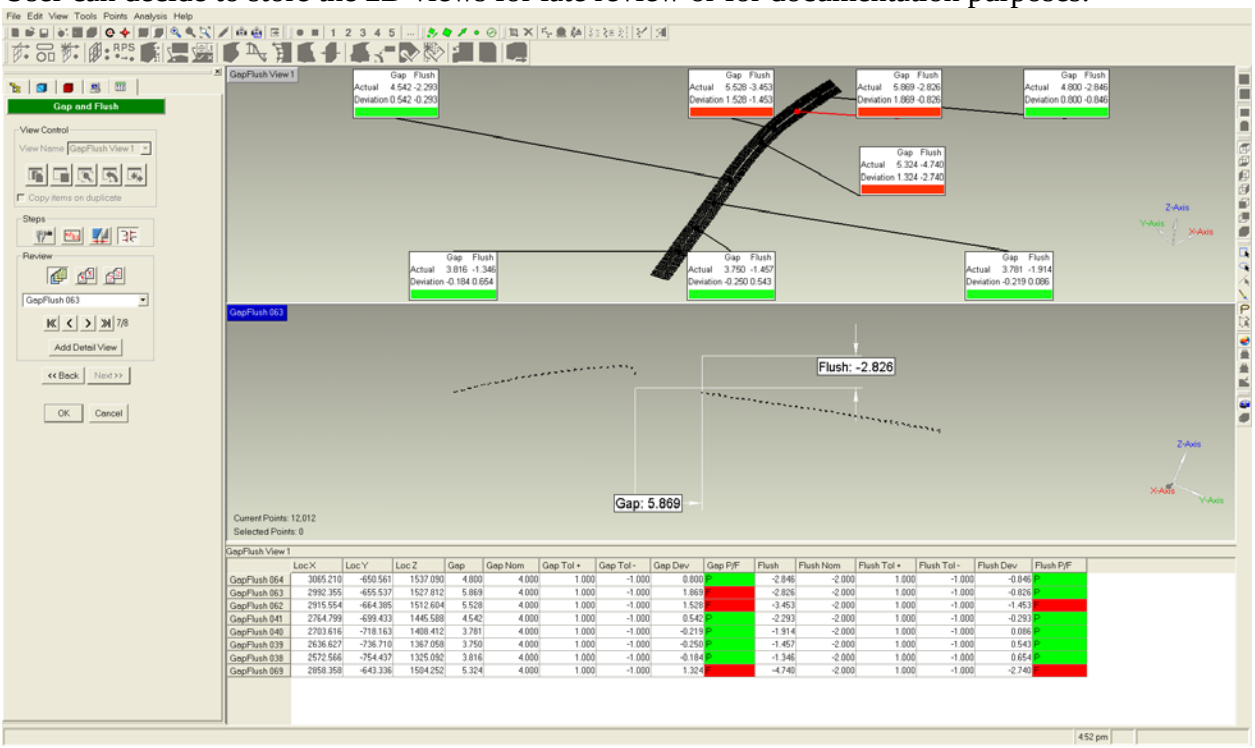
The third step performs the analysis, allowing user to select the cluster of scan lines to be used for the calculation and specify the location of the calculation. User can specify the location by simply clicking on the display window or select a constant spacing or import a set of predefined location from a file.



The calculation is then performed and the results are displayed in an annotation form.



User can then review each calculated location by automatically displaying also the 2D view (fourth step of the process).
A filter can be applied to review only the failed location or the one for which no calculation was possible.
User can decide to store the 2D views for late review or for documentation purposes.



The user can also select one or more location and apply different set of parameters to re-analyze the location.

Benefit to users of 3D scanners

Quantifiable benefits: *Previously, this calculation was performed by taking a manual 2D section and measuring the position of the test section versus the reference section. The user had to identify the area of calculation, make the section, rotate the section, create 2 dimensions for gap & flush (horizontal and vertical). Total time: 1 minute for each section.*
Considering a typical case of a door with 50 location, total time of 50 minutes.
With the new command, the task is reduced to a total time of few seconds.
Total saving for each door study: about 49 minutes.
Non-quantifiable benefits: *the new calculation does not rely on a manual selection of the points to be dimensioned, resulting in higher and more repeatable quality.*

Benefit to users of traditional techniques

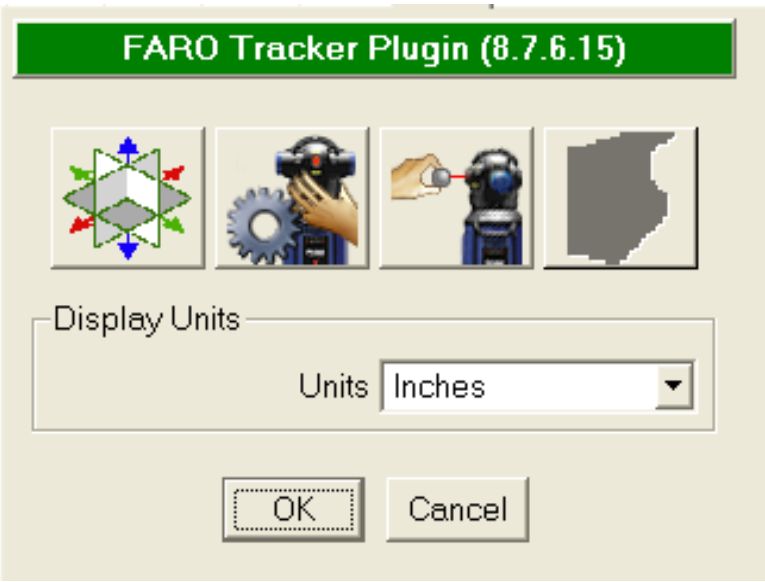
Quantifiable benefits: *Typically the measurement is performed by using a manual gage that is swiped all along the boundary.*
Considering a simple check of the gap of the glove compartment versus the instrument panel, it might require a couple of hours for the manual inspection, the calculation and the reporting
With scanning technique and Qualify, this time can be reduced to 15 minutes (10 minutes for setup + scanning; 5 minutes for the analysis and reporting)
Total saving: 115 minutes (88%)

3 Laser Tracker Real Time connection (new)

A new plug-in is now available to connect to Faro Laser Tracker. The new plugin will allow the user to perform a real-time analysis and comparison of the scanned and collected point.

In addition an SDK is available for development of other types of Laser Trackers.

The new plugin menu is shown below:



Calibration is performed by using directly the FARO tools.

Alignment and measurements are performed from the plugin.

The user can either measure specific features such as plane and or cylinders or free surfaces.

Collection of points can be controlled by parameters from the plugin, such as number of points per second.

By “scrubbing” an area, the collected points will be displayed with a color map depending on the defined tolerance.

Typical applications of a laser tracker are found in aerospace in inspection of large fuselage panels, or in automotive for a quick check of large areas such as a hood or door.

Benefit to users

This new functionality allows users of laser trackers to perform a more complete offline analysis than the software distributed by the OEM along with the hardware.
Typically OEM SW does not allow advanced analysis such as GD&T, sectioning, 2D and 3D dimensioning, thickness analysis as well as the alignment methods are limited.
Real time capabilities of the new plug in addition offer comparable functionalities to the OEM SW and allow users to have a real time feedback of the inspection.

4 Thickness analysis (new)

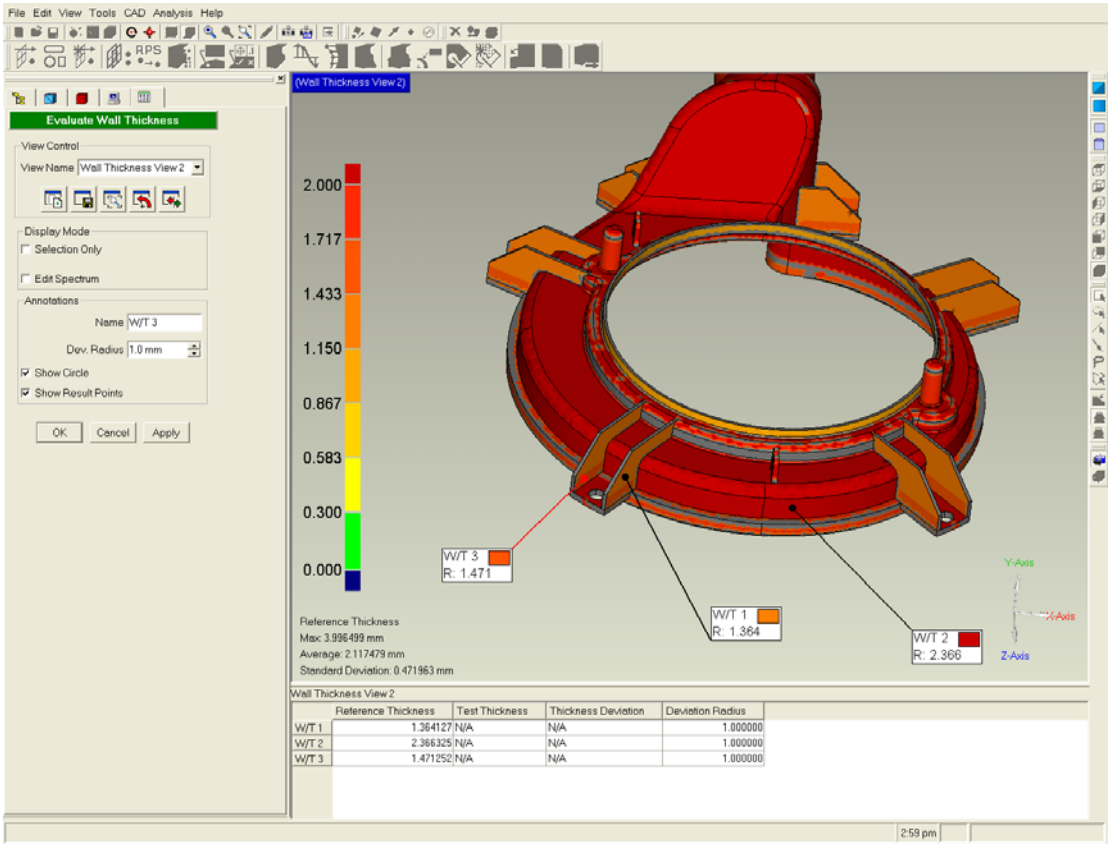
This new functionality allows user to automatically calculate the wall thickness of any object.

User sets up the maximum wall thickness to be considered and computed. A nominal thickness will be computed for the Reference model and displayed with a color map.

After 3D comparison is run, the actual thickness for the model is computed and shown with a color map.

Annotations can be manually created to indicate the thickness at a specified point.

Thicknesses are also displayed in a table.



Wall thickness for the rib is calculated and displayed

The dialog has a control to show the entire model or only the part of the model for which the thickness has been calculated. This option is useful for viewing internal parts of the model.

Benefit to user
The new functionality results in faster analysis of wall thickness.
Without such functionality, wall thickness is analyzed by sectioning the part in few areas and then 2D dimensioning parallel sides of the part. Depending on the complexity of the part, the analysis time with this technique can take up to 1 hour.
This wall thickness function enables analysis in a couple of minutes.

5 3D comparison with user-defined vector (modified)

Two additional calculations have been added to the 3D Compare function:

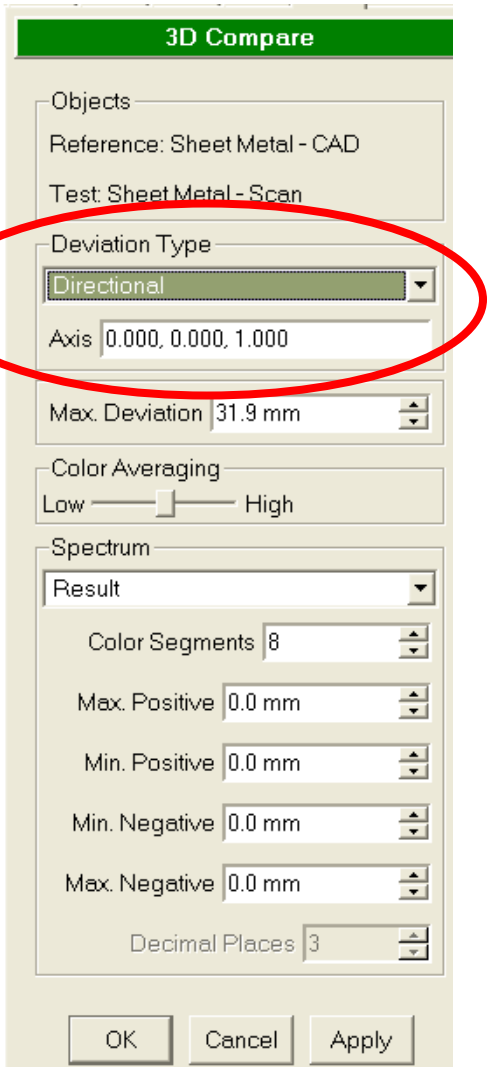
- Along a user-defined vector
- Along the surface normal.

The user can control the type of 3D comparison he wants to perform by selecting the mode from a drop-down menu.

In the case of user-defined vector, the user can pick a datum axis or a plane to define the direction. The Axis vector will be used or, in the case of the datum plane selection, the plane normal direction will be used.

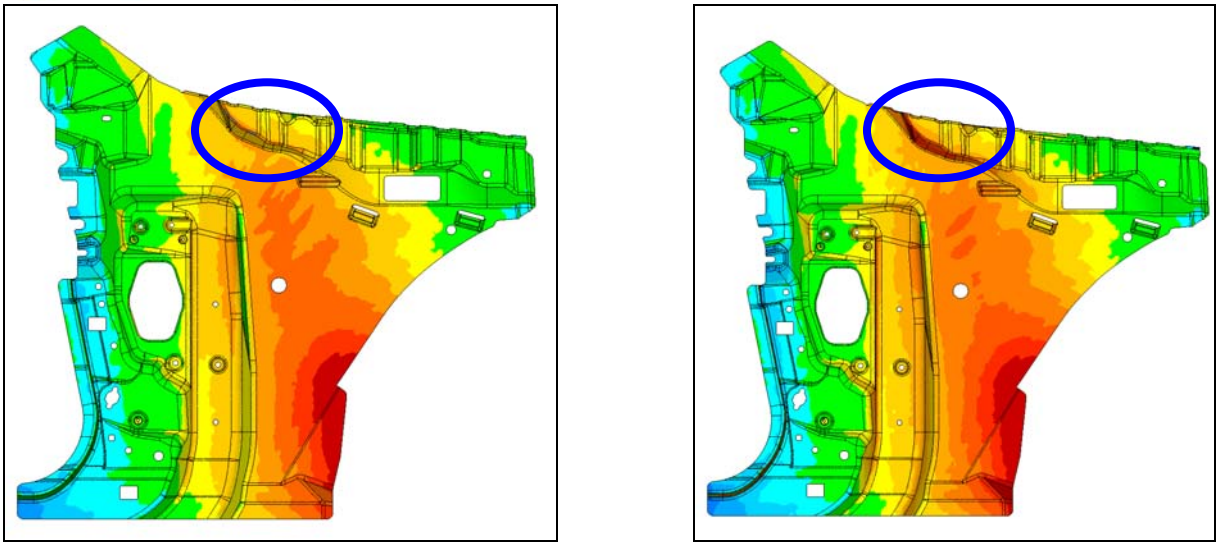
The user can also manually input the direction values.

If normal comparison is selected, the 3D Compare will be performed considering the normal of the selected plane.



Type of 3D comparison

Direction of the calculation

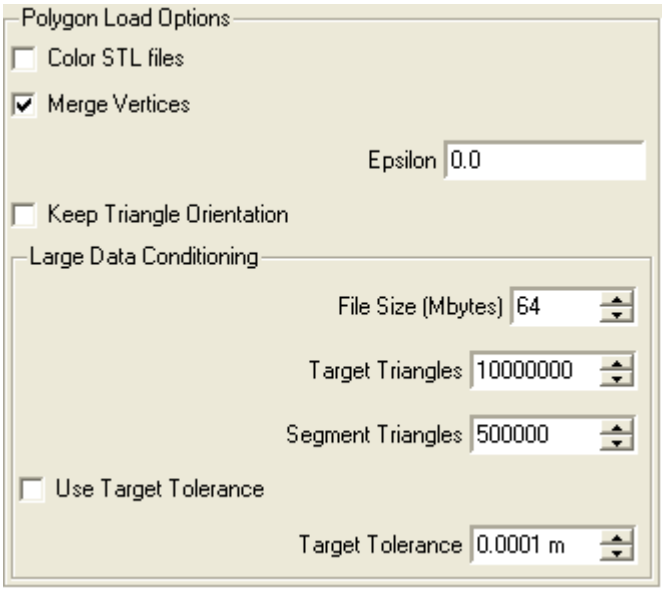


3D minimum distance (left, new) vs. 3D Comparison along Z direction (right).
Major differences are shown in the blue circles due to effect of stamping.

Benefit to user: This new functionality is an enabler of new calculation, particularly useful in sheet metal analysis to study stress caused by a unidirectional load (i.e crash or stamping)

6 Large data handling (new)

Very large polygon files (.obj and .stl) can be loaded by conditioning the data on import. New options are available in Tools > Options to control the total number of loaded triangles, memory usage, and decimation tolerance.



Large data loading options.

This new functionality replaces the Disk Decimate command.

Benefit to user: *The ability to handle large sets of points translates to higher-quality inspection. In addition, the user does not need to break down analysis into subsets, resulting in less total time to perform the analysis.*

7 Edit Correspondence (new)

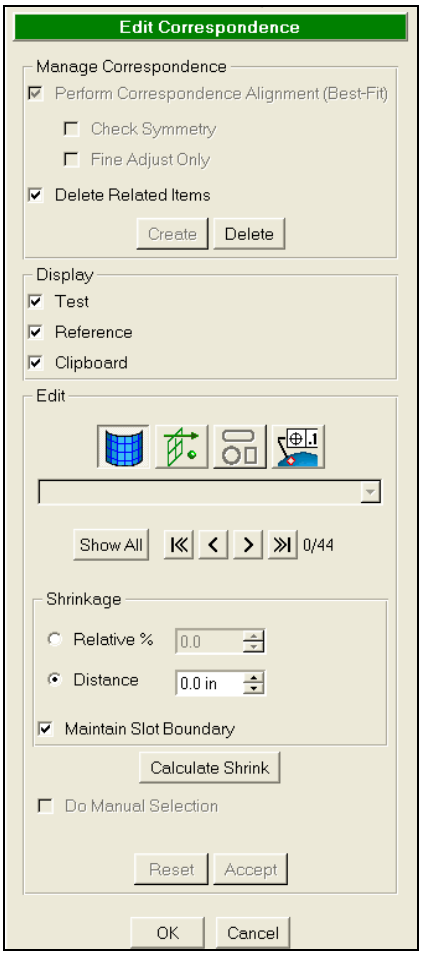
A *correspondence* is the association of a set of points on the Test object to a CAD face on the Reference object. Each point on the Test can correspond to one face on the Reference. The correspondence is not typically of interest to users, but becomes relevant when **Tools > Auto-Create Datums/Features** or **Analysis > GD&T > Evaluate Callouts** does not perform with sufficient precision.

Examples: If a Plane Datum exists on the Reference object, and the corresponding plane on the Test object was scanned with imprecise points on its fringe, those imprecise points might affect the fitting of a plane and cause the Plane Datum to be created less precisely. Similarly, if a Flatness Callout exists on the Reference object, and the corresponding plane on the Test object was scanned with imprecise points on its fringe, those imprecise points might cause the generally perfect plane to be evaluated as non-planar.

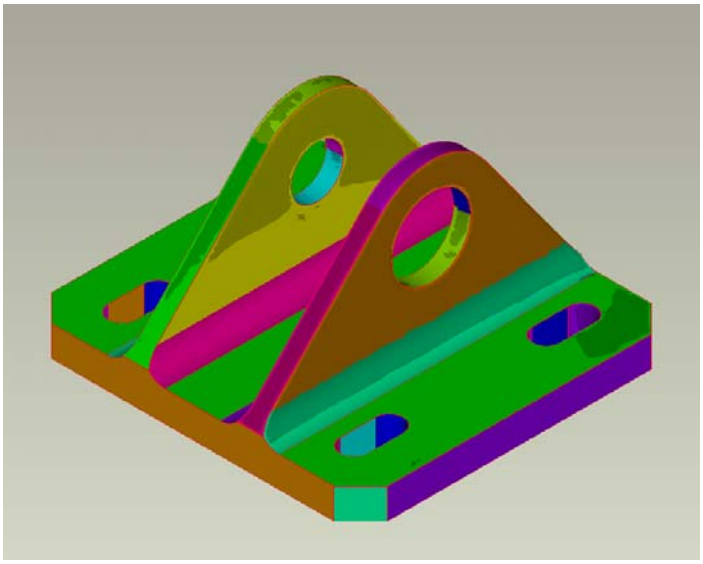
Therefore, it sometimes becomes necessary to edit the *correspondence*. There are two ways to edit the correspondence (only when the Reference object is a CAD object):

- by disassociating a band of Test points (that lie near the fringe of a Reference face) from the Reference face. This is called shrinking the set of Test points.
- by disassociating user-selected Test points from a Reference face, and/or re-associating user-selected Test points from one Reference face to another. For example, consider the scan of a tabletop. It is perfectly planar on the top and bottom, and has perfectly rounded edges. The transfer of a Plane Datum or the evaluation of a Flatness Callout might be imprecise because some points on the round might be incorrectly considered as part of the plane. As a remedy, you can select the points and disassociate them from the top surface, or you can select points and re-associate them to the side (round) surface. Disassociation and/or reassociation of user-selected points (as opposed to uniform shrinkage) is called ***editing by manual selection***.

Tools > Edit Correspondence is functional when a Test and Reference object exist and when one or the other is selected in the Object Manager. It creates a new correspondence if none exists, and (if the Reference object is a CAD object) modifies the correspondence of points on the Test object to CAD faces on the Reference object, whether by shrinkage or by editing by manual selection.



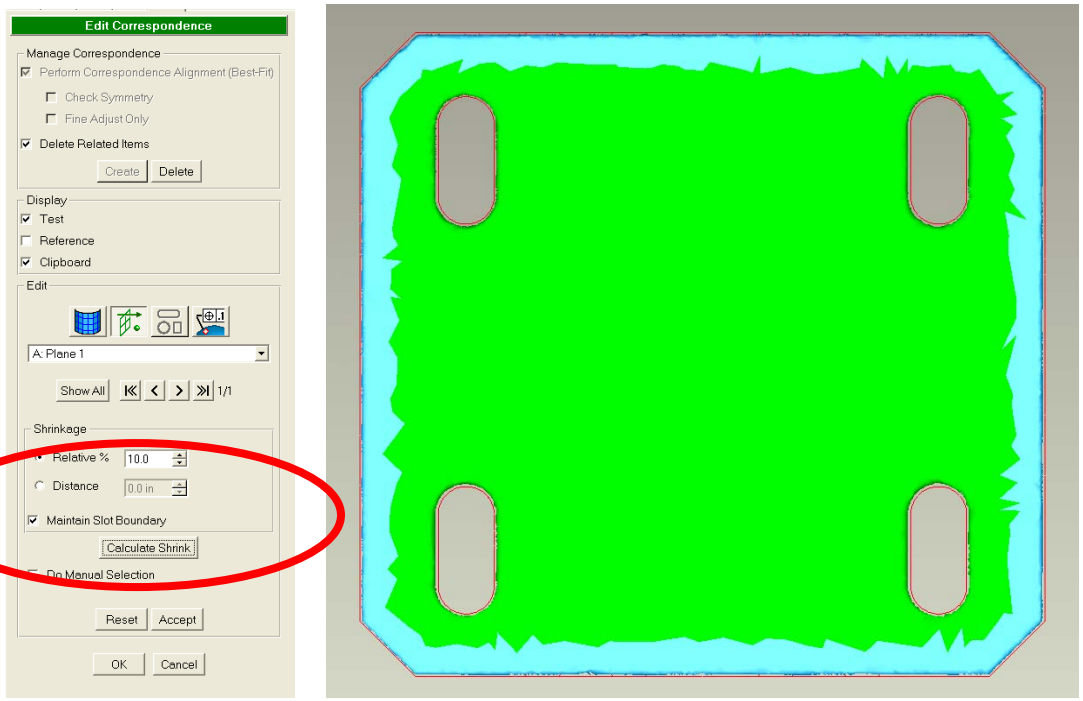
If **Tools > AutoCreate Datums/Features** has been used, a correspondence will have been created. The user can then view and edit the correspondence.



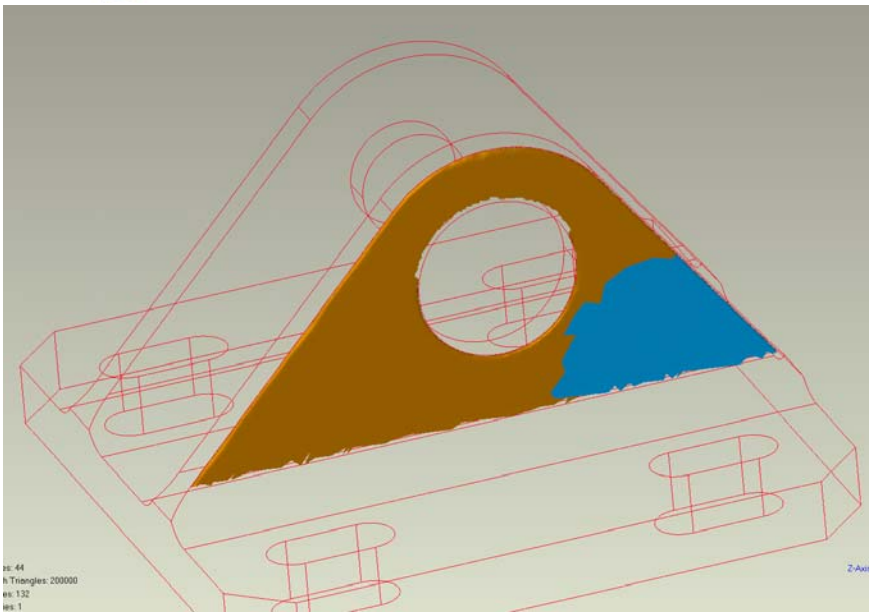
Faces of the model are displayed in different colors

On a face-by-face basis, the user can shrink a set of test points or edit by manual selection. (One way of selecting particular face for this kind of editing is to pick a face by the datum it is associated with.)

The next diagram shows Test points (that correspond to a specfic Reference face) being shrunk so that there is no uncertainty about which face they correspond to. The green area shows the extent of Test points after shrinkage.



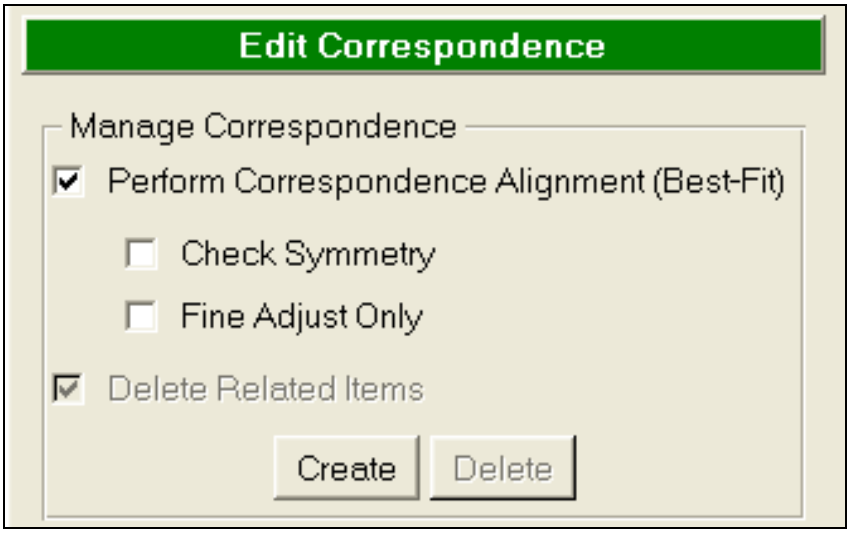
Alternatively, the user can manually select points by standard selection methods and “cut” them from a particular face, or “cut” them from one face and “paste” them to another. See online help for details on selecting and deleting points, or selecting, deleting, and pasting them to an adjoining face.



Manual removal of Test polygons from the correspondence to a Reference face.

Managing the Existence of *Correspondence*

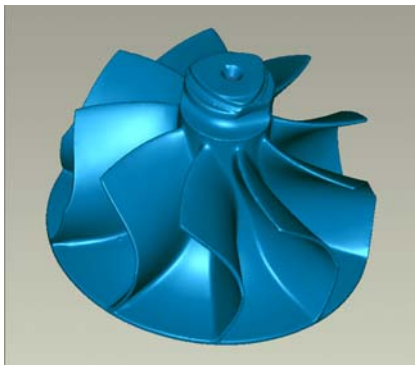
The correspondence of Test points to Reference faces is created internally when Tools > AutoCreate Datums/Features is run, when Analysis > GD&T > Evaluate Callouts is run, or when created manually in the Manage Correspondence section of the dialog (below). Further, an existing correspondence can be deleted and regenerated if necessary, also controlled by the Manage Correspondence section of the dialog.



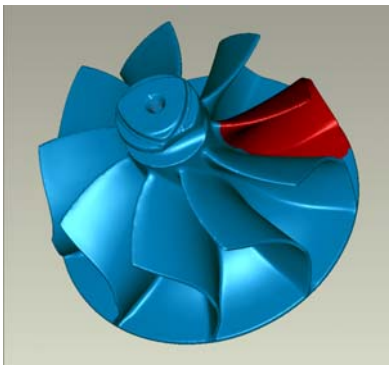
Benefit to user: *This new functionality allows the user to improve the quality of GD&T > Evaluate Callouts and the quality automatic transfer of Datums and Features from the Reference to the Test object.*

8 Partial Sectioning (modified)

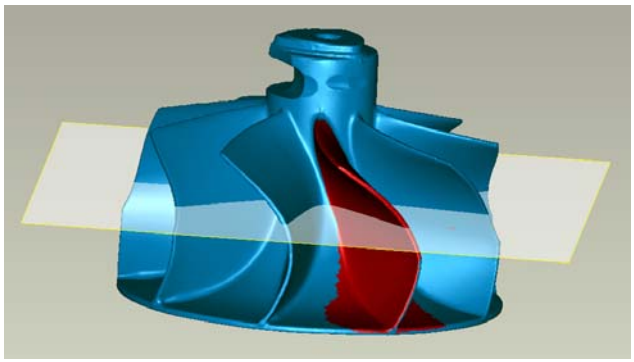
The sectioning command has been enhanced such that it can operate on a selected subset of geometry. If no selection is made, then the whole model will be selected (like the previous functionality).



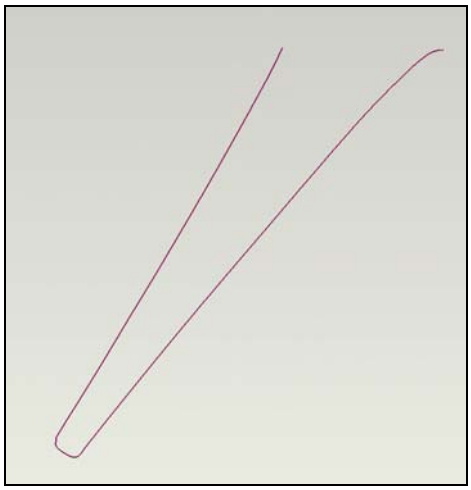
Full part



Selection of an area



Section identification

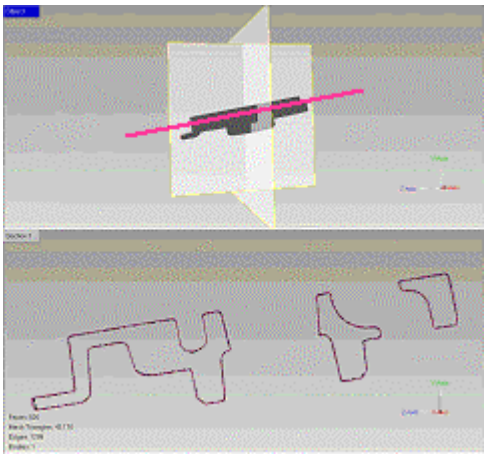


Sectioning result

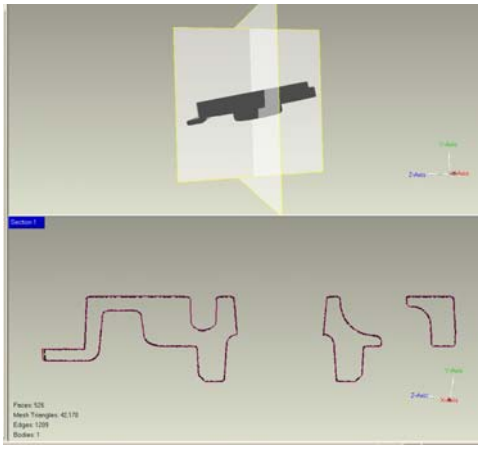
Benefit to user: This new functionality enables limited-size Sections, often simplifying the generation and interpretation of results.

9 Section rotation (modified)

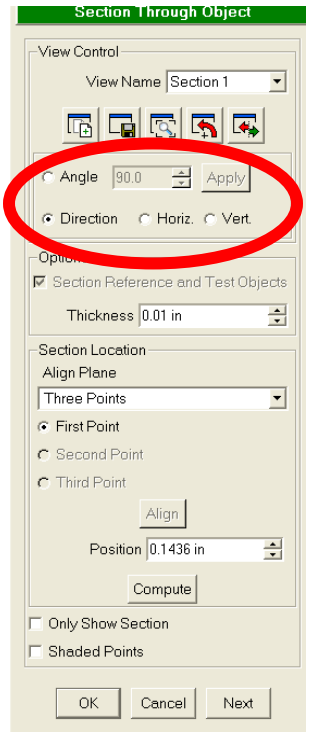
The Section Through Object function has been enhanced so that a Section can be re-oriented by defining its intended horizontal or vertical axis. This simplifies the subsequent use of the 2D Dimensioning tool and other tools.



Before rotation, with user-drawn line indicating intended horizontal



After rotation, the Section assumes the intended angle



Benefit to user: By moving a Section into a more convenient orientation, this feature simplifies and therefore speeds 2D Dimensioning.

10 Save of sectioned point (new)

This new option allows the export of a Section that is comprised of points. The object can be exported in a variety of file formats including Iges (.igs) into any CAD system.

The right-click menu of a Section sub-object now has an Export function.

Benefit to user: This new functionality is a convenient method of exporting a sectioned set of points to a CAD system for further analysis or creation of auxiliary geometry.

11 Registration and Merging

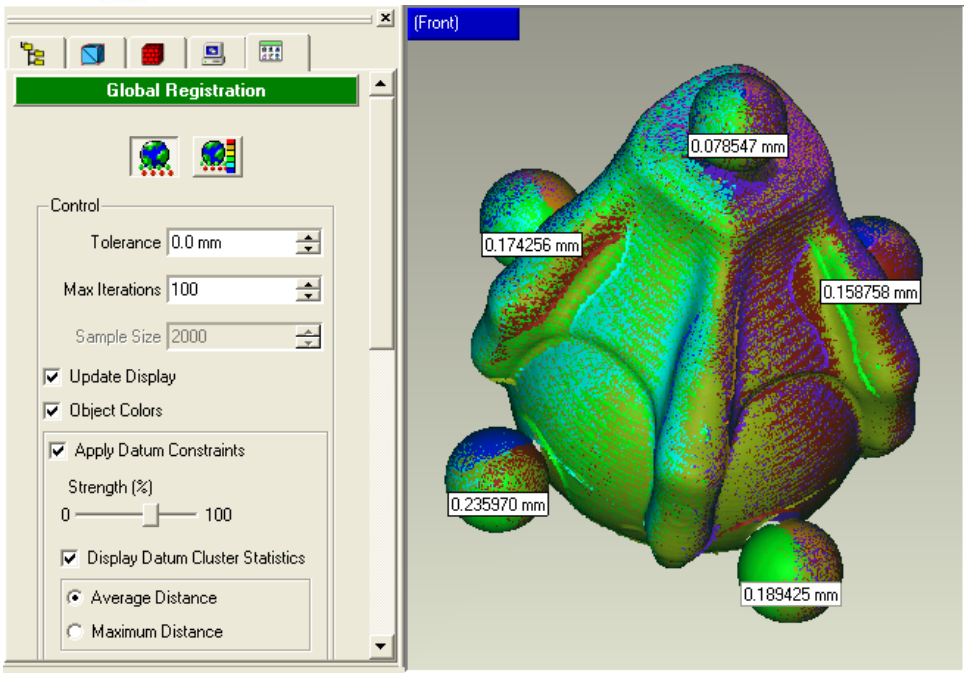
11.1 Constrained Global Registration (modified)

Constrained global registration allows the user to take advantage of targets coming from photogrammetry systems or tooling ball detection when globally registering multiple scans according to their shape.

Qualify has two ways of aligning multiple scans: Global Registration, which is based on the shape of the scans, and Target Registration, which is based on identifying target points on the scans and registering them. The Global Registration command has been enhanced with the capabilities of Target Registration to provide a constrained global registration technique. The point datums are used as constraints, and are only allowed to move a certain amount during the shape-based registration.

One typical workflow for using this command will be the following:

1. Target points are created on individual scans as point datums. This can be either through our own Detect Targets, or as input from an external system (e.g., photogrammetry).
2. Target Registration is run on the scans to register them closely. In the case of using an external system, the scans may already be approximately registered.
3. Global Registration is run with constraints turned on to produce the final result.



Global Registration with Datum Constraints.

Within the Global Registration command, the user can view statistics for the deviations in each target cluster to evaluate the effectiveness of the alignment or to identify problem areas.

Benefit to user: This new functionality allows faster registration when photogrammetry or tooling balls are used.

11.2 Merge

The Merge process for unordered data has been improved to produce better results.

12 Point Phase

12.1 Reduce Noise (modified)

Reduce Noise functionality has been enhanced to produce smoother results without distorting edge and corner features.

13 Polygon Phase

13.1 Decimate Polygons (modified)

Enhancements include:

- **Tolerance-Based Decimation**. A completely new tolerance-based decimation technique is available with much greater performance than any previous version.

- **Triangle Shape Control**. The user can now specify limits for the aspect ratio and height ratio of the resulting triangles to produce meshes optimized for analysis and other downstream applications.
- **Curvature Priority**. The curvature priority can be increased to preserve greater detail in high curvature regions while further reducing triangles in planar or simple regions.

13.2 Deform Region / Offset Selection (modified)

The 'Deform Region' command in Qualify 7 was replaced with a new command that allows the offsetting of a selection while retaining continuity to the surrounding area. This command is very different from the original command, and some users requested that the original functionality be restored. So, the original Deform Region command is now restored as Deform Region, and the new command introduced in Studio 7 is now available as Offset Selection.

13.3 Remove Spikes (modified)

A new Smoothness Level is introduced which can control the level of smoothness that can be attained. The functionality is run iteratively to remove spikes more thoroughly, which removes the need to invoke the command multiple times to actually remove all the spikes, because removing one spike could create another one nearby, as was the case in the original version of this function.

13.4 Fill Holes: Automation Rules (modified)

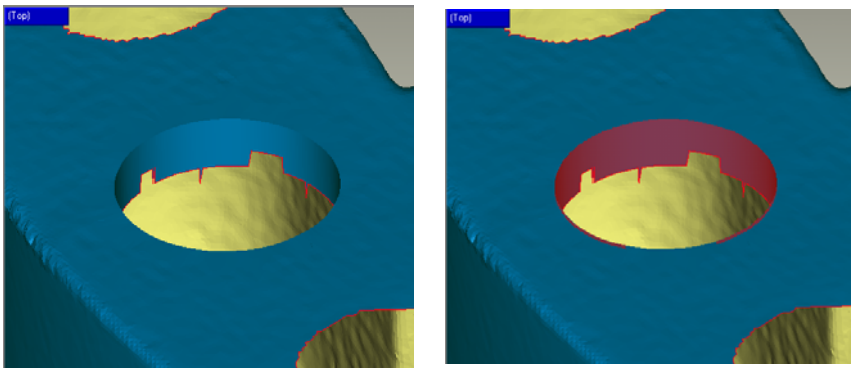
A new automated method of filling holes has been added. This new method is based on user-defined "rules" which simplifies repetitive or complex hole filling. The rules are defined in an external "rules" file (c:\HoleFillRules.txt).

Rules can be created to fill only those holes with a minimum number of boundary edges, or a specific hole perimeter. Detailed information can be found in the online help system for creating custom rules.

13.5 Fill Holes: Cleanup (modified)

Two new Actions, Rim Distortion and Connected Component, have been added to the Cleanup function of Fill Holes.

Rim Distortion – Selects excess cylinder-like data that often surrounds a hole that has been scanned. Once selected the data can be deleted.



Before and after Rim Distortion selection.

Connected Components – Selects data that can be floating pieces of data that are only connected to the rest of the model by a few triangles.

14 Tools

14.1 Align to World (new)

Align to World is a new command that replicates the Datum-Based Alignment functionality but uses the implicit planes, axes, and point of the World coordinate system rather than requiring the user to make them. This command is very similar to the Datum/Feature Alignment command. In this case the fixed object is the world coordinate system. The floating object is the current object.

The following items can be used as implicit datums in the World CSYS:

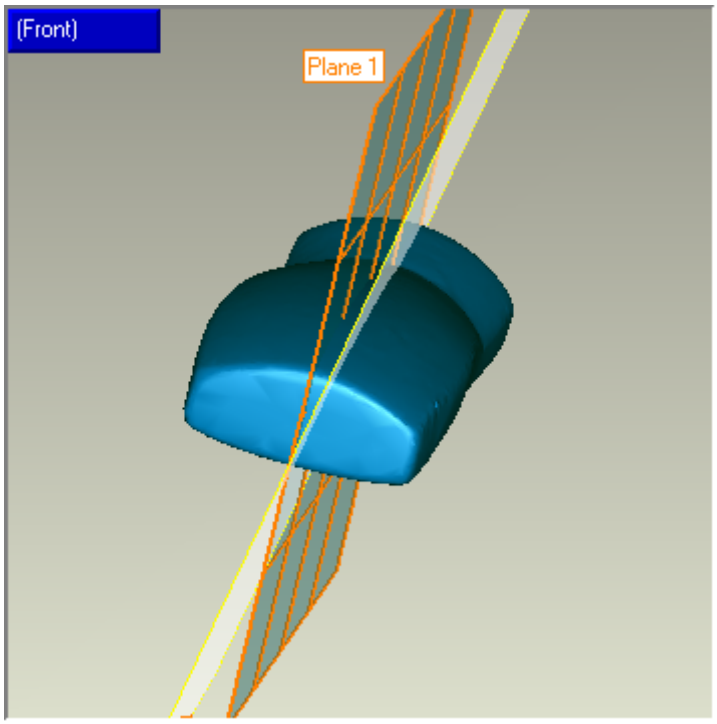
Origin datum point (the intersection point of the X, Y, and Z axes)

X, Y and Z coordinate axes of the world coordinate system

The XY, XZ and YZ planes of the world coordinate system

14.2 Symmetry Datum Plane (new)

A new datum plane creation method has been added to the Create Datums function to detect and create a symmetry datum plane on polygon objects.



A datum plane created as the symmetry plane.

The user must define the approximate position of the symmetry plane by drawing a line or using any of the standard plane definition methods (3 points, system plane, etc.). Upon clicking Apply, the function will evaluate the polygon model in the proximity to the approximate plane and create the appropriate symmetry datum plane.

14.3 Select by Curvature (modified)

This function has been enhanced to produce more consistent results.

15 GUI/Application

15.1 Mouse-Controlled Number Entry (New)

Numbers can now be modified by using the scroll wheel or by clicking and-dragging within text fields. This functionality replaces the presence of the 'scroll wheels' which reduces the size of many dialogs.

- Scrolling. When the mouse pointer is positioned within the input area of a numeric input field, the user can move the mouse scroll wheel forward or backward to increase or decrease the value in the field. This action is equivalent to clicking the "up/down" arrow buttons in the dialog.
- Dragging. When the mouse pointer is positioned within the input area of the numeric input field and the user presses and holds the left mouse button, any mouse movements up or down will increment or decrement the value.

15.2 Licensing Wizard (new)

A new licensing wizard has been implemented which will walk the user through the proper steps for licensing the application, including automatic communication with Raindrop Geomagic licensing servers without e-mail or other manual interaction.

15.3 Progress Bar (modified)

The progress bar has been enhanced with a 'Time Remaining' indicator to provide better feedback to the user on how much time remains for completing a complex operation.