

Steinbichler T-Scan Plugin

For compatibility with Geomagic products, see *Release Notes for Steinbichler T-Scan Plugin*.


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Plugins > T-Scan for Leica or **Plugins > T-Scan for OptoTrak** is the interface in Geomagic Studio and Geomagic Qualify to a Steinbichler T-Scan. (This menu item in Geomagic products is an optional, separately licensed feature. If this item does not already appear on the Plugins menu, download the software from <http://www.geomagic.com/support>, install it according to instructions on the web site, and re-start this procedure.)

The purpose of this (or any) scanner plugin is to eliminate the need to import scan data into Geomagic Studio or Qualify. With the plugin, scanned data exists in the application's Model Manager immediately after the data capture process.

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Activating the Plugin

1. Start **Geomagic Studio** or **Geomagic Qualify**.
2. To activate the scanner control dialog, click the  **T-Scan** icon on the toolbar, or select **Plugins > T-Scan**.

Controls on the T-Scan

After you press the **Start Capture** button in the dialog, the T-Scan button is enabled, and the scanner is in the Paused state. Press *and hold* the trigger button on the T-Scan to scan the physical object. Release the trigger to pause the scanner. Each cycle of the trigger generates a uniquely numbered "Scan N" object in the Geomagic model manager. When a sufficient number of scans are complete, press the Start/Stop Scan button in the plugin dialog.

Controls and Indicators

This section details the controls and indicators on the user interface of the plugin. The major categories of controls are:



- **Hardware Alignment** icon button - Alignment is the synchronization of the coordinate system of a reference object with the coordinate system of the scanner and test object, such that the coordinates of incoming data points can be correctly compared to points on the reference object. This button activates controls and indicators for the alignment process. Every scan must be performed with respect to a known spatial orientation (also called a "coordinate system", also incorrectly called an "alignment"). The spatial orientation remains in effect on subsequent scans and the next time Geomagic Studio or Qualify is started.
 - **Display Units** - specifies the units of measure that will display in the Viewing Area, such as inches or millimeters; not the same as the units that will be stored in the data file.

Define a coordinate system (an orientation) by one of the following methods.



- **Load Transform** button - allows the user to select a **.tfm** file that defines a spatial orientation.




- **Use Arm CSYS** button - sets the spatial orientation (also called Coordinate SYStem) to the arm default, where the arm base is the origin.



- **Laser Capture** icon button - Laser Capture is the process of collecting data points from a physical part. This button activates controls and indicators for the laser scanner.

Definitions: *Ordered data* is a point cloud of consistent density whose points exist in orderly rows and/or columns. *Unordered data* (also called **Raw** data) is a point cloud of variable density whose points exist at any location in space.

- **Display Units** - specifies the units of measure that will display in the Viewing Area, such as inches or millimeters; not the same as the units that will be stored in the data file.

- **Object Options** group - controls the organization of new scans in the Geomagic Model Manager.
 - **Store Data In** dropdown - The set of choices depends on the Data Format below.
 - **New Group** (selectable when Data Format is **Raw Data Only**, **Ordered Data Only**, or **Ordered and Raw Data**) - A new group (named Group *N*) will be created in the Model Manager and the data will be stored therein (in an object named Scan *NNN*).
 - **New Object** (selectable when Data Format is **Raw Data Only**) - A new object named Scan *NNN* will be created in the Model Manager.
 - **Scan *NNN*** (selectable when Data Format is **Raw Data Only**) - Data will be *added* to the *existing* object named Scan *NNN*.
 - **Group *N*** (selectable when Data Format is **Ordered Data Only** or **Ordered and Raw Data**) - Data will be *added* to the *existing* group named Group *N*, in a new object named Scan *NNN*.
 - **Name** field and **Reset** button - indicates the name of the scan object that will be stored in the Geomagic Model Manager. Names are of the form Scan 001, Scan 002, Scan 003, **Reset** restores the numeric part to 001.
- **Scanning Options** - control the operation of the scanner and the display of data.
 - **Automatic Resize** checkbox - specifies that the real-time graphical Viewing Area will automatically zoom to accommodate the incoming data.
 - **Virtual Camera** checkbox - causes the Viewing Area to continuously reorient itself to simulate the view from an imaginary camera on the arm.
 - **Highlight Scan Pass** checkbox - activates scan pass hi-lighting. When selected, the incoming scan data will appear red. Otherwise the incoming scan data will match the light green of previously created scan passes.
-  **Start Capture** icon button - begins the data capture process by passing control to the scanning device.
- **Data Options** group - controls the storage of data in the Geomagic Model Manager.
 - **Data Format** dropdown - specifies the kind of data that will be stored in the Geomagic Model Manager. (This choice affects the **Store Data In** dropdown above.)
 - **Ordered Data Only** - Data will be stored as ordered data.
 - **Raw Data Only** - Data will be stored as unordered (raw) data.
 - **Ordered and Raw Data** - Data will be stored as Ordered data and as Unordered (raw) data in two separate objects.
 - **Enable Clip Plane** checkbox - activates the **Clip Plane** group of controls (which allows a spurious plane such as a tabletop to be elim-

inated from a scan automatically). When enabled, use **Clip Plane** group of controls in the **Advanced Options** group, below.

- **Advanced Options** checkbox - activates the display of the controls and indicators below.
 - **Remove Overlap** checkbox - specifies that an entire scan line be rejected if it is mathematically “too close” to the previous scan line. This setting prevents an over-abundance of scan data.
 - **Remove Outliers** checkbox and **Spacing** decimal field - specifies that points be rejected if they are more than Spacing distance from any other.
 - **Reduce Noise** checkbox and **Noise Level** slider - performs a degree of smoothing on the surface that is suggested by the captured points.
 - **Ordered Data Options** group - affects data that is stored in the Model Manager as Ordered Data.
 - **Spacing** decimal field - specifies the exact spacing of the grid-like structure of the ordered data.
 - **Max. Edge Length** decimal field - specifies the maximum length of any side of any square cell. Gaps in the data that are wider than this value are considered to be holes in the object.
 - **Max. View Deviation** decimal field - specifies the change in the scanner angle that causes one scan object to terminate and another to be started automatically. All points in an ordered data object must be visible from a single point of view, so this field controls the automatic breakdown of a “complex” scan into multiple single-view scans.
 - **Filter Angle** decimal field (0.0 to 90.0 degrees) - offers the ability to ignore points collected by the scanner beyond the specified angle. This can result in cleaner data. This operation, like smoothing, is per-scanline.
 - **Raw Data Options** group - affects *all incoming data*, even if it will be stored in the Model Manager as Ordered data.
 - **Shade Points** checkbox - specifies whether to apply shading to the unordered data so that it can be better visualized in the Viewing Area (possibly at the expense of performance).
 - **Sample Points** checkbox with **Spacing** decimal field and **Max. Error** decimal field - specifies whether to reduce the density of points on each scan line. Sampling occurs at the end of each scan pass. **Spacing** is the target distance between points. Sampling tends to “smooth” (reduce the precision of) a scan, so the **Max. Error** parameter controls the maximum distance that a point is allowed to move as the result of such smoothing. Point reduction is performed to achieve the requested Spacing along each scan line, except at specific locations on the line where the distance between points is allowed to be smaller in order to accommodate the **Max. Error**.

- **Set to Defaults** button - sets all Advanced Options to their default values.



- **Real-Time 3D Comparison** icon button (visible in Geomagic Qualify, not Geomagic Studio) - Real-Time 3D Comparison is a scanning method during which the deviations between scanned points and a reference object are graphically illustrated in real time.. This button activates the laser scanner in a mode that performs real-time 3D comparison of the scanned object to a reference object.
 - **Display Units** - specifies the units of measure that will display in the Viewing Area, such as inches or millimeters; not the same as the units that will be stored in the data file.
 - **Initialize** button - initializes the comparison process by creating an empty Result object in the Geomagic Model Manager.



- **Start Compare** icon button - begins the data comparison process by passing control to the scanning device.
- **Objects** group -
 - **Reference** - indicates the name of the object in the Geomagic Model Manager that is designated as the Reference object.
 - **Scan** - indicates that the test object is the "New Object" that is being scanned.
- **Max. Deviation** field - indicates the greatest difference between corresponding reference and test points to allow in the test data. Points beyond this deviation are not included in the test data set.
- **Color Averaging** slider (five settings from Low to High) - affects the degree to which colors are blended and averaged across the entire surface, like an airbrush that hides small blemishes.
- **Display** group - controls various aspects of the graphical display:
 - **Test Object** checkbox - specifies whether to display the raw test data points during the data capture process.
 - Color radio buttons - specifies the one attribute that will be colored in the Viewing Area:
 - **Color Reference** - color will appear on the reference object.
 - **Color Test Points** - color will appear on test points.
 - **Color Deviations** - color will appear on whisker lines that extend between test points and the reference object.
 - **Edit Spectrum** checkbox - allows modification of the color coding scheme of the deviation map in the Viewing Area.
 - **Edit Texture Resolution** checkbox - specifies whether to display the following controls:

- **Texture Resolution** group - For the purpose of generating color on the reference object, a grid with uniform cell sizes is placed across its surface. Each square cell is called a texel. Scan points are projected onto the texels. When 0 scan points correspond to a texel, the texel is gray, indicating that the test object has no data in that region for color to be rendered on the reference object. When one point corresponds to a texel, the texel assumes the color that represents the distance of that scan point from the reference. When two or more scan points correspond to a texel, the texel assumes a color that represents the one point that is furthest from the reference.
 - **Resolution** dropdown - controls the total number of texels on the surface of the reference object. The choices are:
 - **Automatic** (the default) - the software selects the number of texels.
 - **Fixed Texture Size** - the user selects an absolute size of each texel.
 - **Fixed Resolution** - the user selects an absolute number of texels. The absolute number of texels is spread across the reference object, which therefore determines the size of each texel.
 - **Texture Size** dropdown (applicable when **Resolution** is Fixed Texture Size) - specifies an absolute number of texels, measured in megatexels (millions of texels).
 - **Texel Size** dropdown (applicable when **Resolution** is Fixed Resolution) - specifies the absolute width of each square texel, usually in millimeters.
- **Statistics** checkbox - specifies whether to include the following indicators:
 - **Maximum Distances** - indicates the maximum distance between any two corresponding points on the test and reference objects.
 - **Average Distances** - indicates the average deviation between corresponding points on the test and reference objects.

- **Standard Deviation** - indicates the standard deviation between corresponding points on the test and reference objects.

*The **OK** and **Cancel** buttons described here apply to the **Hardware Alignment**, **Laser Capture**, and **Real-Time 3D Comparison (Qualify only)** functional areas simultaneously.*

- **OK** button -

For the **Hardware Alignment** function - saves the currently configured alignment. The same alignment will be in effect the next time this plugin is started.

For the **Laser Capture** function - performs any incomplete shading and saves scanned data into the Model Manager.

For the **Real-Time 3D Comparison (Qualify only)** function - saves scanned data into the Model Manager as a point object named the same as the reference object, designates the point object as the test object, and creates a Result object in the Model Manager that indicates differences between the test and reference objects.

- **Cancel** button - cancels all un-OK'd processing in the **Alignment**, **Laser Capture**, and **Real-Time 3D Comparison** functional areas.

Detailed Examples

This section contains examples that are referenced earlier in this document.

ALIGNING TEST AND REFERENCE PARTS WITH GEOMAGIC QUALIFY

1. Load a CAD object into the Model Manager and designate it as the reference object.
2. Start the scanner plugin.
3. Scan a portion of the object, at least enough points that it could be aligned to the reference object using the best-fit alignment function of Geomagic Qualify.
4. Exit the plugin by clicking the **OK** button.
5. Use **Tools > Alignment > Best Fit Alignment** on the test and reference objects (which aligns the test object to the reference object by detecting the similarity of their surfaces).

The side effect of this process is that it creates an internal *transformation matrix*, which is a mapping of the spatial difference between the reference object and the test object. In this case, the transformation matrix represents the spatial difference between the reference object and the place where a test object will lie in the test fixture.

6. Place a real test part in the test fixture.
7. Start the scanner plugin again.
8. Click the large **Laser** icon to activate scanning mode. Begin scanning. Scan data appears on the screen in alignment with the CAD reference object.
9. Exit the plugin by clicking the **OK** button. In the Model Manager, notice that the newly created scan object is now the test object.
10. To prepare to scan another test object, go to step 7. Every new test object will be aligned correctly.


EXAMPLE OF LASER SCANNING



1. Click the **Laser Scanning** icon.
2. In the **Laser Capture** dialog, **Data Options** section, pick a **Data Format**. This specifies whether future scan(s) will be stored in the Model Manager as ordered data, unordered data, or as both (in two separate objects). With Geomagic Qualify, you probably want unordered data because it is an exact representation of the object and lends itself to inspection. With Geomagic Studio, you probably want ordered data because it is easier to handle during an engineering process.
3. In the **Laser Capture** dialog, **Object Options** section, pick a **Store Data In** option. This controls whether the scan data will go to the Model Manager as: a new object in a new object group, as a new stand-alone object that is not in an object group, as data to be appended to an exist-

ing scan object, or as a new object in an existing object group. Your choice depends on how you like to organize scan data.


4. To perform a scan and thus transfer data to the Geomagic Model Manager:

- Click the **Start/Stop Capture** icon button  .
 - Press and hold the trigger button on the scanner and make scan passes. At any time, release the trigger to pause scanning. The scanner acts as a virtual camera when scanning is not active. Press and hold the trigger to resume scanning.
 - Click the **Start/Stop Capture** icon button to end scanning.
5. If all scanning is complete, press **OK** to close the plugin.
 6. If it is necessary to change the **Data Format** option, go back to Step 2.
 7. If it is necessary to change the **Store Data In** option, go back to Step 3.
 8. Go to Step 4 and perform the next scan.

EXAMPLE OF REAL-TIME 3D COMPARISON

This section describes the concepts of computer-aided inspection with Geomagic Qualify and any Geomagic scanner plugin.

1. The first step of a CAI process is to align the coordinate system of a reference object to the scanner so that collected data can be compared to the reference object in the same coordinate system. Use one of the alignment methods summarized at **Hardware Alignment** on page 3.
2. Next, designate a CAD object as the reference object in the Geomagic Model Manager.
3. Click the **Real-Time 3D Comparison** icon button.
4. Click the **Initialize** button. The **Start Capture** icon button becomes active.
5. To perform a scan and thus transfer unordered (raw) data to the Geomagic Model Manager:

- Click the **Start/Stop Capture** icon button  .
 - Press and hold the trigger button on the scanner and make scan passes. At any time, release the trigger to pause scanning. The scanner acts as a virtual camera when scanning is not active. Press and hold the trigger to resume scanning.
 - Click the **Start/Stop Capture** icon button to end scanning.
6. If more scanning is necessary, go to Step 5.
 7. When scanning is complete, click **OK** on the dialog. Scanned data is saved into the Geomagic Model Manager, the saved object is automatically designated as the test object in the Model Manager, and the comparison results are saved to a Result object in the Model Manager.