MobileScan3D PlugIn for Geomagic

MobileScan3D

V. 1.0 - Version February, 2006
For Geomagic Qualify 8 SR1 and subsequent releases
For Geomagic Studio 8 and subsequent releases

By Steintek GmbH

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In this guide the screen shots are taken with Windows XP in the explanation common to all operating systems.

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Table of Contents

Introduction

Welcome!

Thank you for acquiring **MobileScan3D**, an optical multi-axes system designed to facilitate the non-contact data acquisition.

MobileScan3D shall make the control tasks friendlier to you and at the same time bring several advantages for your company.

Enjoy using our systems!

Notes About This Manual And On-line Help

This manual and the On-line Help assume that you are familiar with Windows environment.

If not, we recommend you to learn to know a bit more about your system before start using MobileScan3D.

We use certain conventions to facilitate the utilization of this manual and On-line Help.

Mouse

Click	Press the primary mouse key and then release it. Use it to start an application, to choose a menu or dialog option and to drag objects.
Double click	Click the primary mouse key twice.
Drag	Keep the primary mouse key pressed while you drag the mouse.

Keyboard

<X>	A character in the keyboard or a string to be typed in.
<Ctrl>+<A>	Keep the key <Ctrl> pressed down while you press the key <A>.

Terminology

Cancel	Click on this button to not complete an action or to not change settings.
Spin button	This field allows you to increment or decrement a value using the arrow keys.
Check Box	This element is a switch field. If the option is selected, this field has a tick. If not, the field is empty. You may select more than one choice in a group of fields. The selection is not mutually exclusive.
Choose	Select a command or function by clicking on the corresponding object.

Support For Technical Problems

Please contact your reseller for a local and immediately support or visit please Steintek site: www.steintek.com.

General Information

System Requirements

PC with: Microsoft Windows 2000/XP operating system

Output interface requirements: USB 2.0 and FireWire IEE 1394.

Installation

How to Install the Software Drivers

By the first time you switch on the system, Windows "Found new Hardware Wizard" or "Add new Hardware Wizard" appears.

Insert the MobileScan3D CD-ROM into the computer's CD-ROM drive.

If the Wizard asks you for the location of the drivers select the Drivers folder on your CD-ROM.

If there is a problem with the Wizard you can also run the DriverInstall.bat file that is found in the drivers folder on your CD-ROM. The DriverInstall.bat will install the drivers automatically.

How to Install the Software

After you have installed the drivers, you may proceed and install the MobilScan3d Software

1. Turn your computer on.
2. Place the Win3DS MS3 Setup CD-ROM in the drive.
3. Run SETUP.EXE.
4. Click **[Next]**.
5. Read the software license agreement. Click **[Yes]** if you accept the terms.
6. The **[Install]** window will display. Click [Next]. The installation procedure will start.
7. Select **[PMAC 00 - USB0 - Plug and play]** and click **[OK]**. If it is not available click **[Insert]** and select the USB port.

When the installation is complete, click **[Finish]**.

Usually you don't have to uninstall Win3DS program. In case you have or you whish to do it, please follow the steps hereunder described:

How to Uninstall the Software

1. Start Windows 2000/XP.
2. Click the Start button in the task bar, select **[Settings]** and then click **[Control Panel]**.

3. In the Control Panel window, double-click **[Add/Remove Programs]**.

4. In the Add/Remove Programs Properties dialogue box, select **[MobileScan3D]**, and then click the Add/remove button.

5. Click **[YES]** if you wish to remove MobileScan3D program from the computer, or **[NO]** if you wish to keep the program on the computer.

6. Click the **[OK]** button when the dialogue box informing that the program is removed appears.

Plugin for Geomagic

Plugin Prerequisites

This plug in requires a Geomagic product listed in the heading. To verify your current version, run the applications and select **[Help | About Geomagic Product Name]**. In the text box you see the current software version.

Plugin Installation

Verify installation of Geomagic product listed in the heading

Copy the MobileScan3DPI.dll into the Plugins folder of your Geomagic product.

Technical Support

For support on Geomagic products visit please Geomagic's site: www.geomagic.com.

For support on Steintek products visit please Steintek site: www.steintek.com.

MobileScan3D Plugin for Geomagic

Activating the Plugin

Start your Geomagic application and switch on your MobileScan3D system before selecting **[Plugins | MobileScan3D]**.

Figure 1 – MobileScan3D Plugin

Alternatively you may press the icon:

Figure 2 – MobileScan3D icon

Selecting the Hardware Configuration

Select from the dropdown menu **[Configuration]** the option correspondent to your hardware configuration:
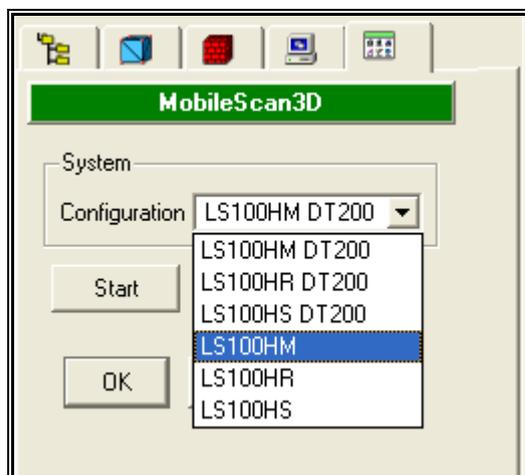
Figure 3 – Hardware configuration

LS NNN RR DT200, where:

LS	Sensor type: Line Sensor
NNNN	Sensor measurement range: 100, 400, 1000, 1500mm
RR	Sensor resolution: HR for HighRes, HS for HighSpeed, HM for HighMix
DT200	If rotary table is available on the system

[Start] initialize the system. Sets the hardware parameters and performs a system reference move.

[OK] and **[Cancel]** closes the plugin dialog box.

The hardware system remains activated if the [Start] button was pressed before pressing **[OK]** or **[Cancel].**

[Apply] reserved. No function in this context. (See Filter controls)

After you press **[Start]** the system is ready for use and the scan control panel is open.

MobileScan3D Controls

Scan Controls

Use this control panel to set the scanning parameters for a complete automated measurement task.

Note: See "Selecting the Hardware Configuration" to learn how to activate this control panel correctly.

MobileScan3D system allows you to perform automated measurement tasks. When scanning a part, you may want to have it scanned in different angles and positions, or you may have different object features that you would like the system to take in consideration when scanning it (different color intensity on the object: darker and lighter parts).

For this variety of conditions and parameters, MobileScan3D gives you the possibility of defining scan tasks. Each scan task is a definition of parameters for one view of the part. A group of scan tasks can be saved to one file and used for scanning at another moment.

This feature allows you to scan an object using the most best parameters for the object feature in certain position: shiny parts with more light, parts with details with more resolution, etc.

For defining the scans, you have to use the Scan Control panel, which has three sections:

- Start and End Scanning Positions Definition: used to define the "from" – "to" scan range

- Sensor Sensitivity and Laser Powers Definition: used to define the sensor parameters for the defined scan range

- Scanning Tasks Management: used to create and edit individual scan tasks that contain the individual scan range and laser definitions of a scanning.
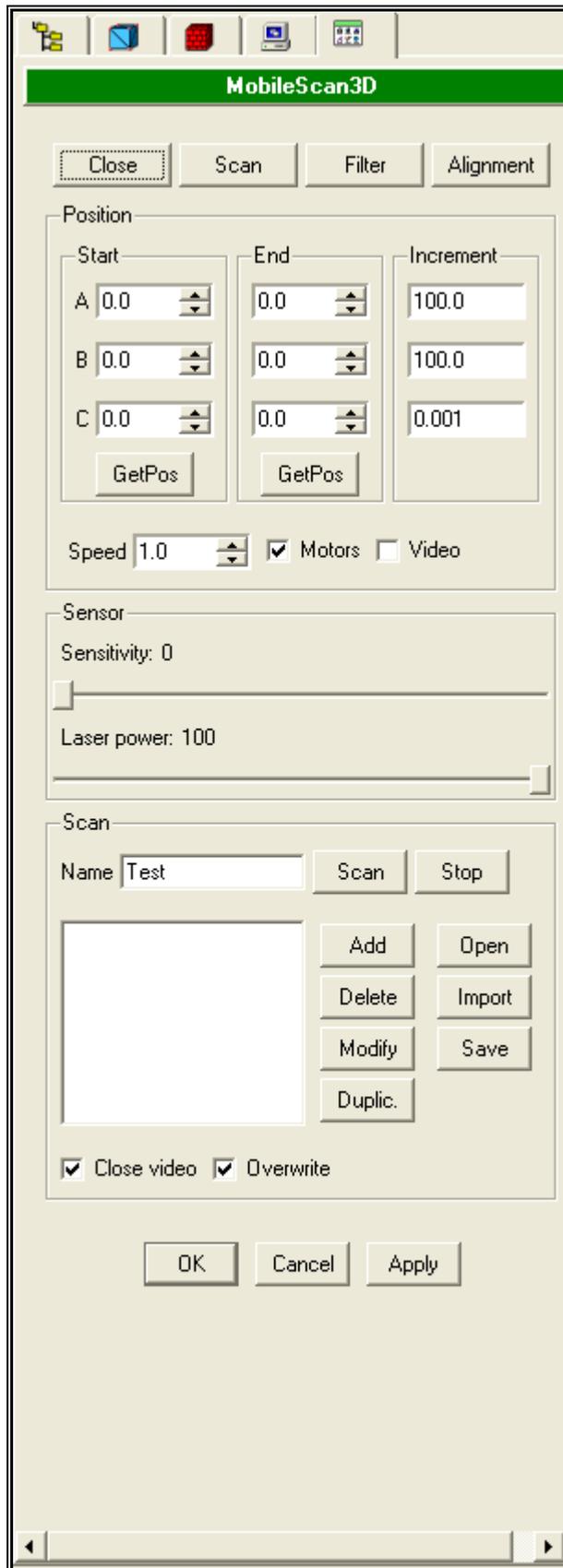
Figure 4 – Scan Controls

Start and End Scanning Positions Definition

This panel let you define the start and end positions of the system's rotary axes - swivel head(s) and rotary table, if available - and consequently the sensor position.

[Position]

A: Parameters for rotary A-Axis (rotary table)

B: Parameters for rotary B-Axis (1st swivel head- horizontal one)

C: Parameters for rotary C-Axis (2nd swivel head - vertical one)

Column **[Start]**: defines the scanning begin positions in degrees.

Column **[End]**: defines the scanning end positions of the rotary axes in degrees.

Column **[Increment]**: defines the step sizes, in degrees, for positioning the rotary axes.

Figure 5 – Start and End Scanning Position Definition

[Speed] Scanning speed in degrees/sec. The speed will define the line spacing. Higher values will cause a very fast scanning, with a wider line spacing (pitch). For better scanning results, the generated grid should be square.

Recommended Speed in degrees/s:

Range / Type	HighRes	HighMix	HighSpeed
100 mm	0.2	0.6	1.8
400 mm	0.4	1.2	1.8
1000 mm	0.4	1.2	1.8
1500 mm	0.4	1.2	1.8

[Motors] Switch on/off the rotary axes motors. If the motors are off, the system can be positioned manually.

[Video] If activate, displays/hides the video preview window. This window facilitates the adjustment of sensor parameter and consequent scanning optimization for a specific part: shiny, very dark or white.
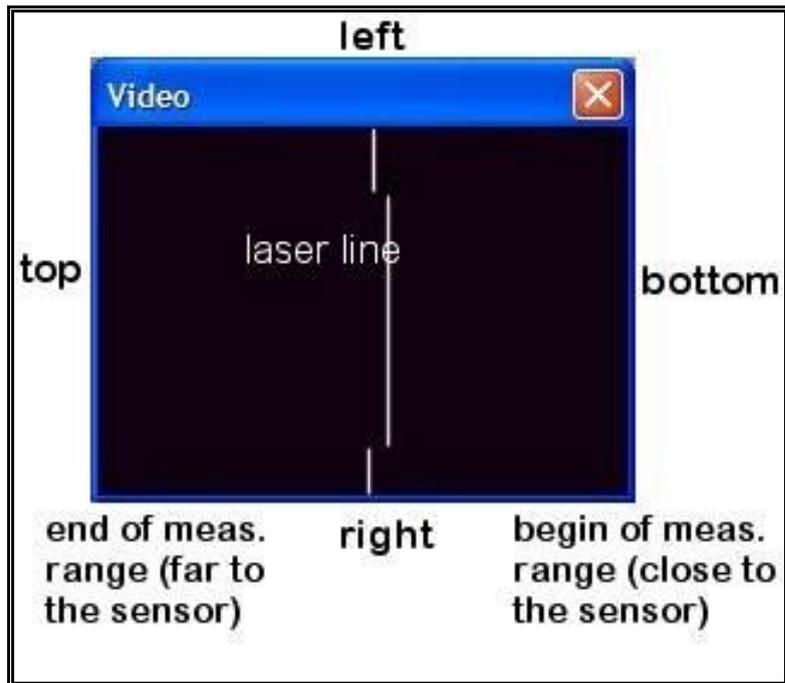
Figure 6 – Video preview window

ATTENTION: The video preview is mirrored and rotated!

Sensor Sensitivity and Laser Powers Definition

The two slides control conditions for the laser line sensor.

[Sensitivity] Defines the exposure time of the camera in percent. Use higher values for very dark parts, and a lower value for very reflective and shiny parts. Activate the video window for a better control of this parameter. The line shown in the video window should be as clear as possible.

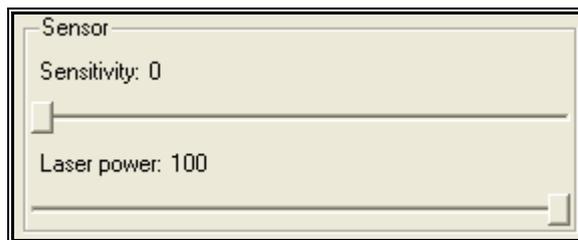**[Laser power]** Defines the brightness of the laser in percent.

Figure 7 – Sensor Controls

In general keep the laser power to the maximum value and adjust the sensitivity while the video window shows a thin white line.

Decrease the laser power if the line is still too bright, even if sensor sensitivity = 0 already.

Scanning Tasks Management

For repetitive scanning tasks you can define individual scans, group them to a task and store it in one file. All the parameters used for the scan are available for the future scans.
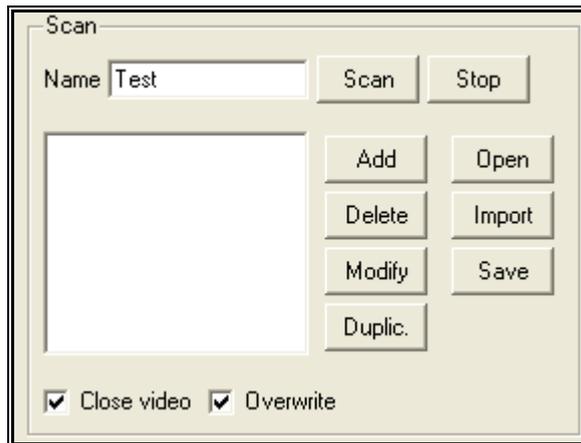
Figure 8 – Scanning Tasks Management

[Name]: Name of the scan that contains the defined scanning parameters.

[Scan]: Starts scan of defined scanning tasks in the scan list.

[Stop]: Interrupts scanning process. The current scan will be stopped and the following tasks will not be done.

[Open]: Loads an exiting scanning definition. Scan definition files have the extension XML. Choose the scan definition and press [open] in the open dialog box.
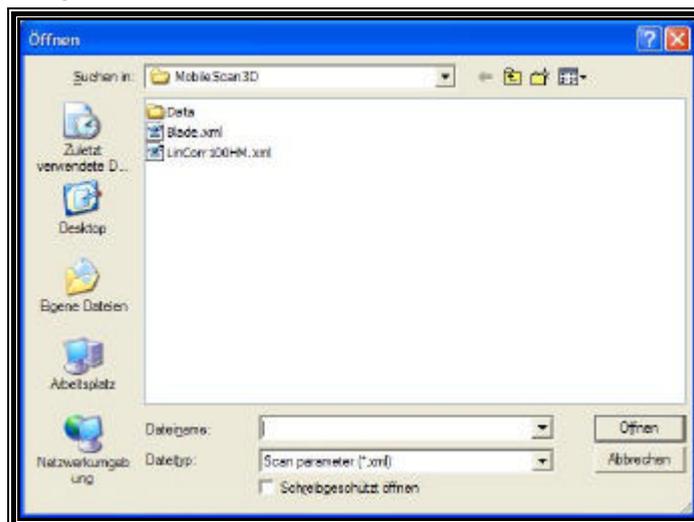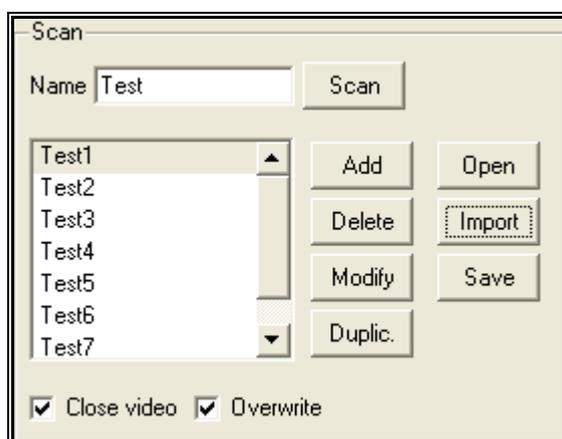

Figure 9 – Open window

Figure 10 – Sample of loaded scan task list

[Import]: Adds an exiting scanning definition to the definitions already loaded. Choose the scan definition and press [open] in the open dialog box.

[Save]: Stores selected or all definitions to a single file. Choose Yes to save the selected definitions only or no to save all definitions in the scan list in the appeared dialog box.

[Add]: Includes actual parameter values as a new scan task definition to the list. The scan is added after the last selected in the scan list.

[Delete]: Remove selected scan task definition and the corresponding scan data from the list.

[Modify]: Enables you to change the parameters of the scan tasks selected in the list. After clicking [Modify] the label of the button changes to [OK]. Click it again to finish the modify process.

[Duplicate]: Makes one or more copy of the selected scan task in the list. The basic parameters like sensor controls, start and end scanning positions are kept. You may overwrite or change them if necessary. If not necessary, you keep them and give only the new angle where the scan should start.

E.g. you define a scan and would like to have it exactly the same when you rotate the rotary table axis (A-axis) every 45° degrees. This feature is also available for the B-axis.

[Close Video]: If active, closes the video preview window before starting a scan. Use the video preview window to control the sensor parameters for an optimized data acquisition.

[Overwrite]: If you repeat a scan task and this option is checked the previous acquired data will be overwritten. E.g. you change the sensitivity of an already existing scan and repeat the scan, the data of the first process will be replaced and shown.
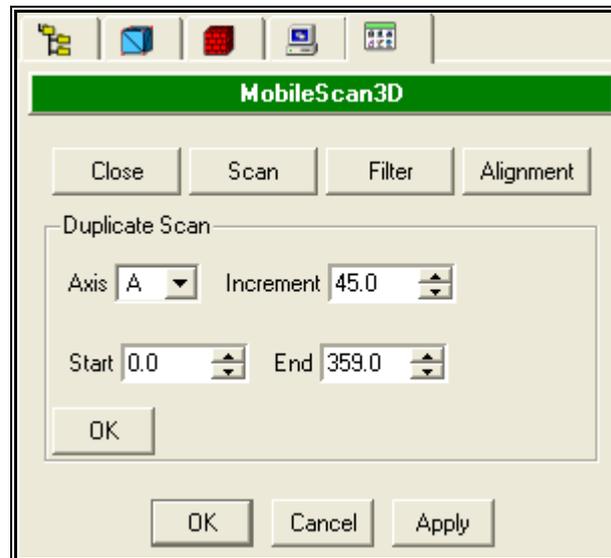
Figure 11 – Duplicate Scan

Filter Controls

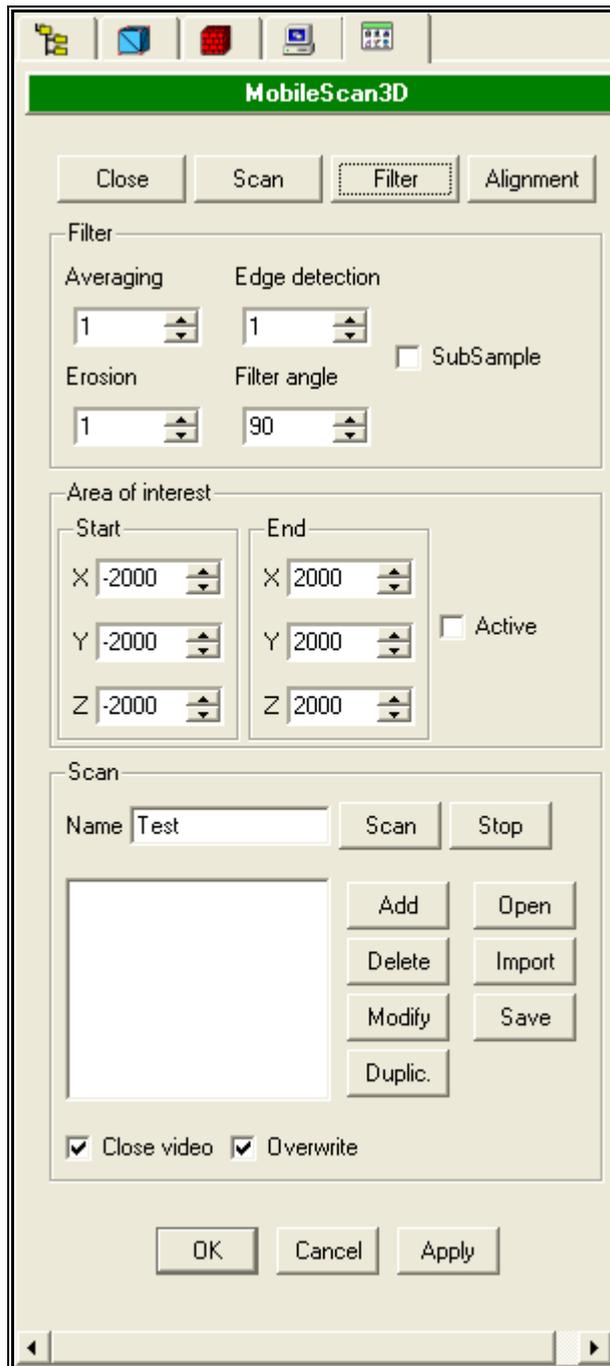This panel enables the control of parameters for data filtering.

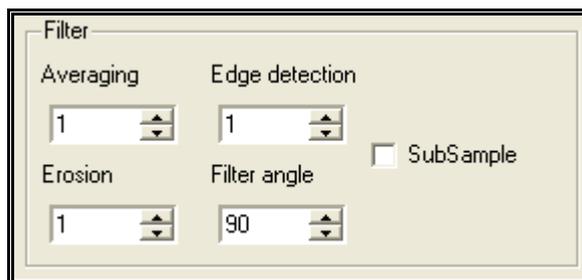Figure 12 – Filter controls

Filter area

Figure 13 – Filter options

[Averaging]: Smoothes the surface of scanned 3D data. The value indicates the number of neighbouring points used for the averaging process.

Recommended value: 1

Use 0 for no surface smoothing

5 for high surface smoothing

[Edge detection]: This option prevents edge smoothing. The averaging process stops on detected edge points.

1.0 for low edge detection, only high deviations in depth are detected as edges

0.1 for high edge detection, small deviations in depth are detected as edges

0.0 edge detection is off

[Erosion]: Deletes the boundary of the scan. The factor defines the width of the boundary band.

0 = no points will be deleted

5 = boundary band includes the 5 outer points

[Filter Angle]: Maximum allowed angle between the connecting line of two neighboring points and the direction of the laser beam. Value range from 0 to 90 degrees.

0: very low amount of points will be transferred to Geomagic

90: every acquired point will be transferred to Geomagic (feature is off)

This avoids Geomagic to create cells between points where probably no material is (gab, hole).

Filtering needs processing time! If you don't need this feature, select 90 degrees (default value) for fastest data transfer.

[SubSample]: If it is checked the system generates additional points. Thereby the amount of data becomes 4 times larger.

If the distance between neighbouring points exceeds the edge detection limit no sub-sampled point will be generated. This avoids Geomagic to create cells between points where probably no material is (gab, hole).

Area of Interest

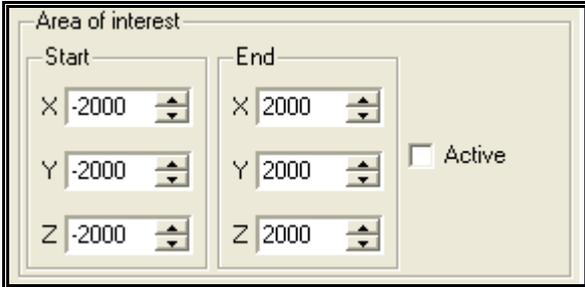Define a volumetric area of interest in Cartesian coordinates.

Figure 14 – Area of Interest definition

[Start Column]: Discard points with a smaller X, Y or Z value than specified.

[End Column]: Discard points with a higher X, Y or Z value than specified

[Active]: If activate, the area of interest is used when transferring data to Geomagic.

Apply button

All selected scans will be transferred again to Geomagic. E.g. you have already performed a scan and you want to change the filter values or the area of interest. Select the scan or scans in the list, click modify and change the values. Click **[Apply]** and the data will be retransferred and shown.

Alignment Controls

This panel enables four different tasks:

[A-Axis adjustment]: For rotary table users. It enables the synchronization of the rotary table coordinate system with swivel head coordinate system.

[Linear Correction]: 2. It enables the check and eventual correction of sensor accuracy.

[Set A axis zero]: Set the current A-axis position to zero.

[Set B axis zero]: Set the current B-Axis position to zero.
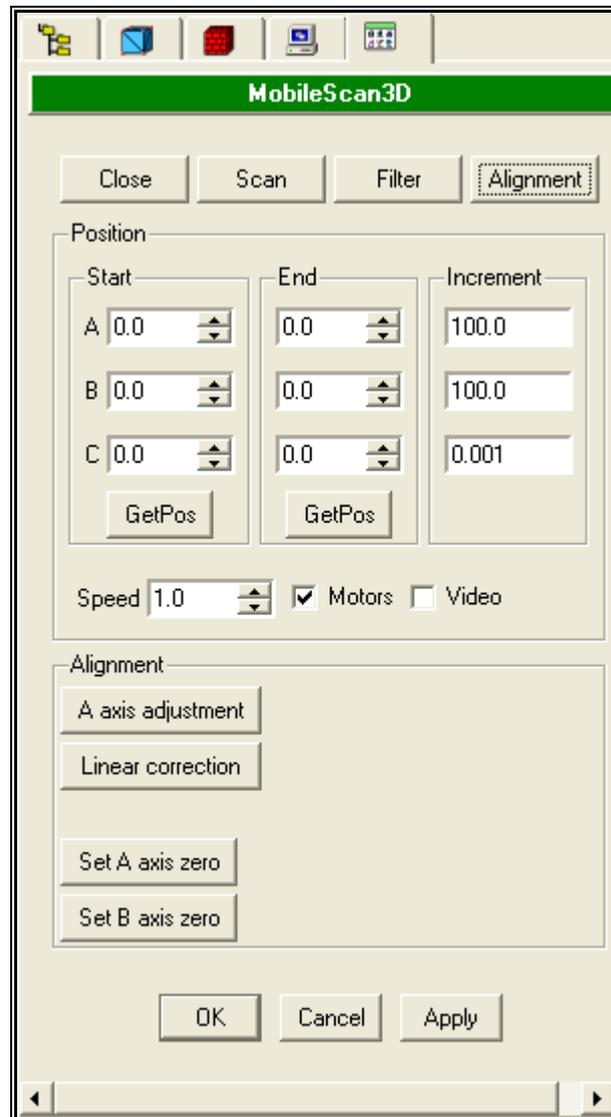
A-Axis Adjustment (rotary table)

Figure 15 – Alignment controls

Click on **[A-Axis Adjustment]** to access the rotary table adjustment controls.
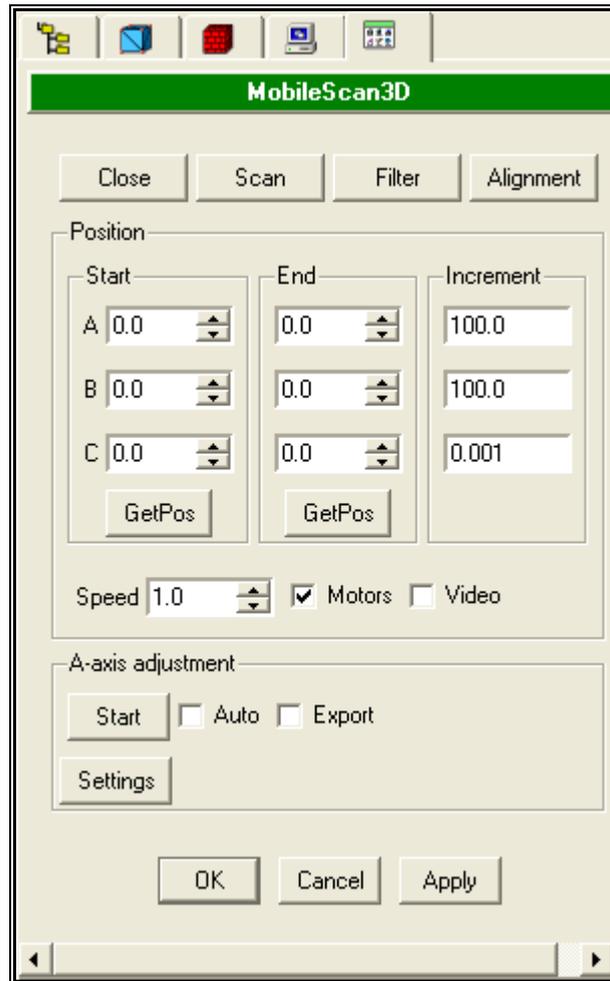
Rotary Table Adjustment Controls

Figure 16 – A-Axis alignment

[Start]: initiates the a-axis calibration procedure.

[Auto]: If activated, the calibration procedure is repeated as long as the changes of the coordinate system values are less than the maximum allowed deviation.

[Export]: Saves data of measured sphere (all measured positions) as a GPD files in the MobileScan3D folder.

[Settings]: Opens the settings control panel that contains the needed information for the a-axis calibration.

Before starting the calibration you may choose an adequate calibration sphere. There are different sphere sizes. You have received one or more calibration spheres along with your MobileScan3D system. Depending on the sensor installed in your system you may use one or other calibration sphere. To choose the correct one, see the table below.

NOTE: Before starting any calibration procedure, assure that the A-Axis (rotary table axis) and B-Axis (horizontal swivel head axis) are roughly parallel to each other.

Sensor Measurement range	Calibration sphere (diameter)	Approx. distance between rotary table center and

	(diameter)	calibration sphere
= or < 100 mm	10mm	65mm
= or > 400 mm and < 1000 mm	20mm	80mm
= or > 1000 mm and < 1500 mm	30mm	80mm
= or > 1500 mm	30mm	80mm

Preparing the System for the A-Axis Calibration

1. Place the correct sphere on the rotary table.

2. The sensor, the sphere and the center of the rotary table should be in one line

3. Open the video window by clicking the **[Video]** button.

4. Switch off the motors by clicking the **[Motors]** button.

5. Position the laser line on the center of the sphere.

ATTENTION: The middle of the laser line should be in the middle of the sphere!

6. To achieve this position move the tripod and the sensor until the video preview looks similar to the video on Figure: Sphere on video preview.

    a. For sensors with measurement ranges higher than 100mm the sphere should be closer to the center of the window.

    b. The laser line should be at right angle with the fictitious line between the sensor, the sphere and the center of the rotary table.
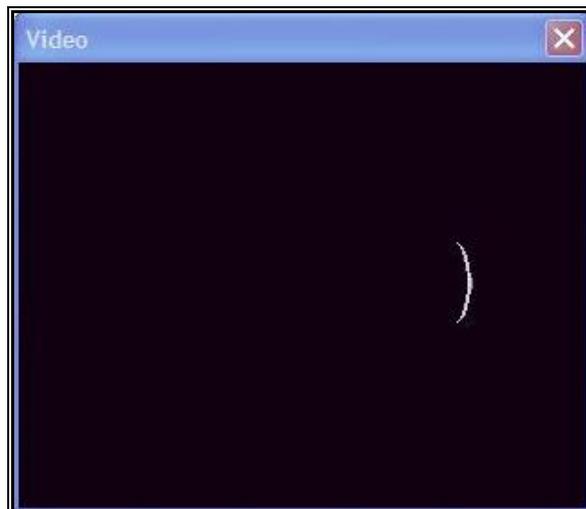

Figure 17 - Sphere on video preview

7. Switch on the motors and click **[GetPos]** to get the current sensor position.

8. Open the Settings control panel by clicking the **[Settings]** button.

9. Specify the settings for the adjustment. See please explanation below.

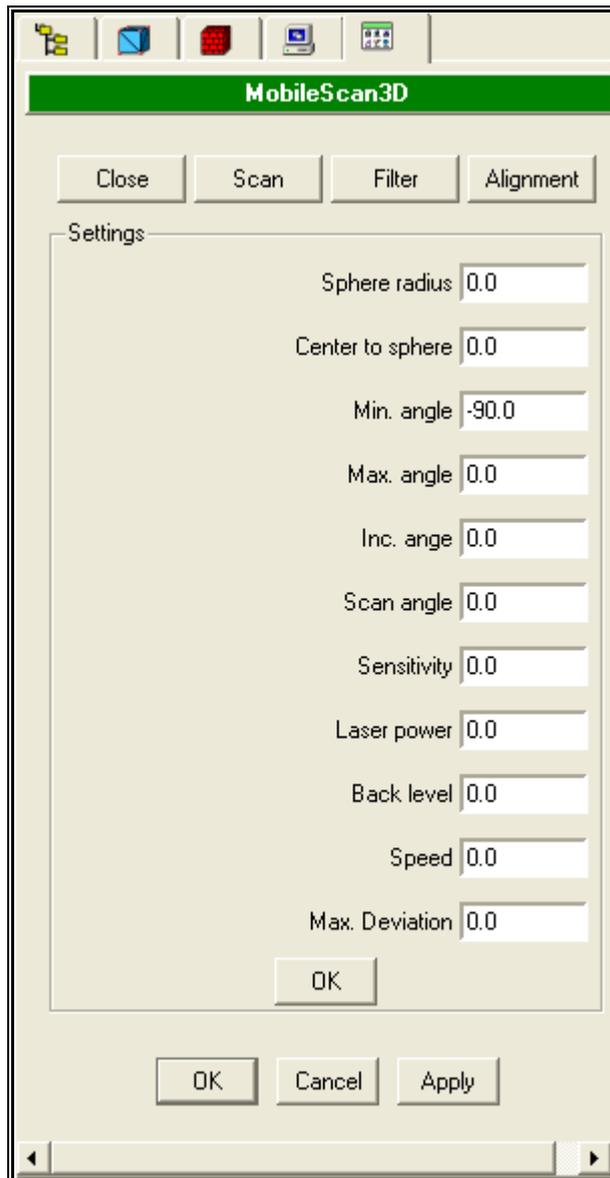10. Now you the system can start the A-Axis Alignment Procedure.

Figure 18 – Settings panel

[Sphere Radius]: Type in the radius of the sphere that you are using for the calibration: 5, 10 or 15mm.

[Center to Sphere]: Type in the approximate distance from the center of the rotary table to the center of the sphere. This value will be corrected automatically after the calibration.

[Min. Angle]: Minimum used angle of A-axis during the adjustment in degrees. Typical: -90.

[Max. Angle]: Maximum used angle of A-axis during the adjustment in degrees. Typical: 90.

[Inc. Range]: Step size, in degrees, between the different measurements during the adjustment. Typical: 30.

[Scan Angle]: C-axis angle range, in degree, during adjustment. Typical: 1.2.

[Sensitivity]: Exposure time of the camera in percent. Recommended values: 35 for 100mm sensors and 10 for other sensor types.

[Laser Power]: Laser power in percent. Recommended value: 100.

[Back Level]: Background noise rejection in percent. Recommended value: 30.

[Speed]: scanning velocity in degrees/s. Recommended value: 0.5 for HighRes sensors, 1.0 for other sensor types.

[Max. Deviation]: The stop criterion for the automatic calibration. Auto calibration finishes when the changes of coordinate system are less than the Max Deviation. Recommended value: 0.005 mm.

[OK]: The values are applied and the dialog is closed.

Starting the A-Axis Alignment Procedure

Once you have specified the settings and positioned the sphere on the rotary table you may start the calibration procedure.

If the option **[Auto]** is activated, the system will pop up a window informing you when the calibration is finished and succeed.

1. Click **[START]** to begin the a-axis alignment procedure.

Linear Correction

Environmental temperature as well system warm up time can influence the overall system accuracy.

Using the linear correction function, you can assure the quality of the measurement results during the system warm up time and also during the temperature variations occurred during the day or when moving the system from one environment to another.

During the warm up system time, you shall use the linear correction more frequently. Use the linear correction between measurements and as long as a correction factor is found. This may happen during the first hour of use.

Alternatively, using macro feature, you may include the linear correction in your measurement task.

To use the linear correction a reference artefact is needed. There are three linear artefact sizes.

Depending on the sensor used, you may have one or another. See please the table hereunder to find out which is the adequate linear artefact for your system.

Sensor Measurement Range	Artefact
100mm	L070, 70mm length
400mm or 1000mm	L300, 300mm length
1500mm	L700, 700mm length

How to position the reference artefact

1. Set the artefact horizontally, as shown on the Figure 19 – Artefact correct position. Correct laser line position on the front plane.

2. Position the LinCorr artefact in the height of the laser beam. The C-Axis angle should be zero (you may check it on the position control panel) and the laser line should to be on the top of the front plane (Figure 19 – Artefact correct position. Correct laser line position on the front plane.)

3. Place the artefact in the middle of the measurement range. Adjust the artefact in a way that the distance between the front plane and the beginning of the measurement range is the same as the distance between the back plane and the end of the measurement range. Use the video preview and the

position control to check this position. See figures Figure 20 – Video preview of the laser line on artefact front plane and Figure 21 - Correct laser line position on the back plane. and Figure 22 - Video preview of the laser line on artefact back plane.

Figure 19 – Artefact correct position. Correct laser line position on the front plane.
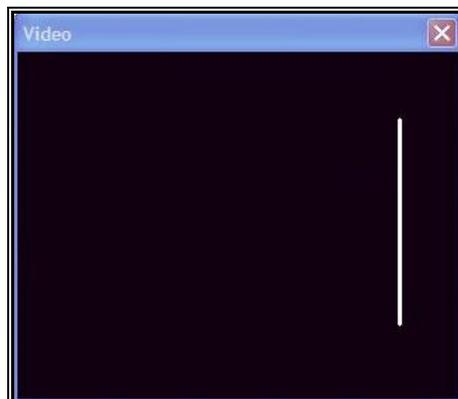

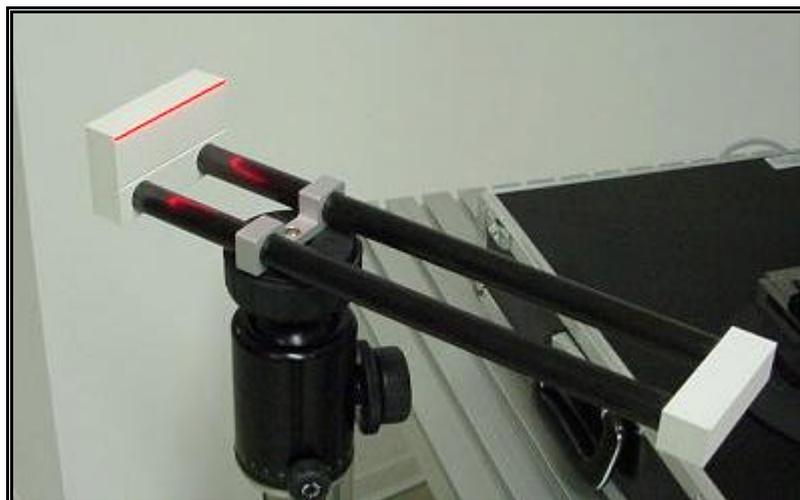Figure 20 – Video preview of the laser line on artefact front plane

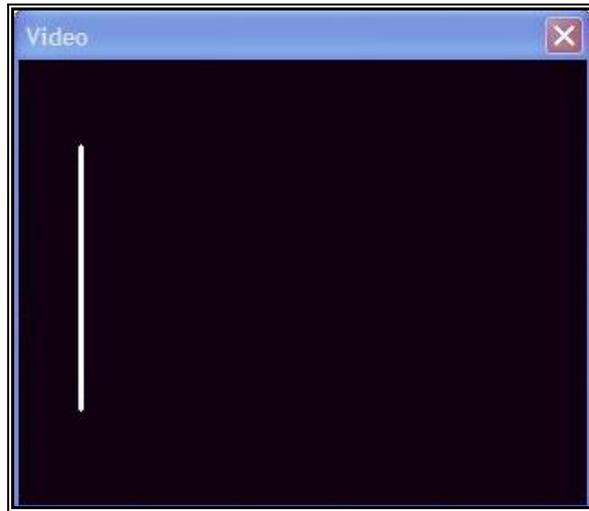Figure 21 - Correct laser line position on the back plane.

Figure 22 - Video preview of the laser line on artefact back plane

Starting the Linear Correction Procedure

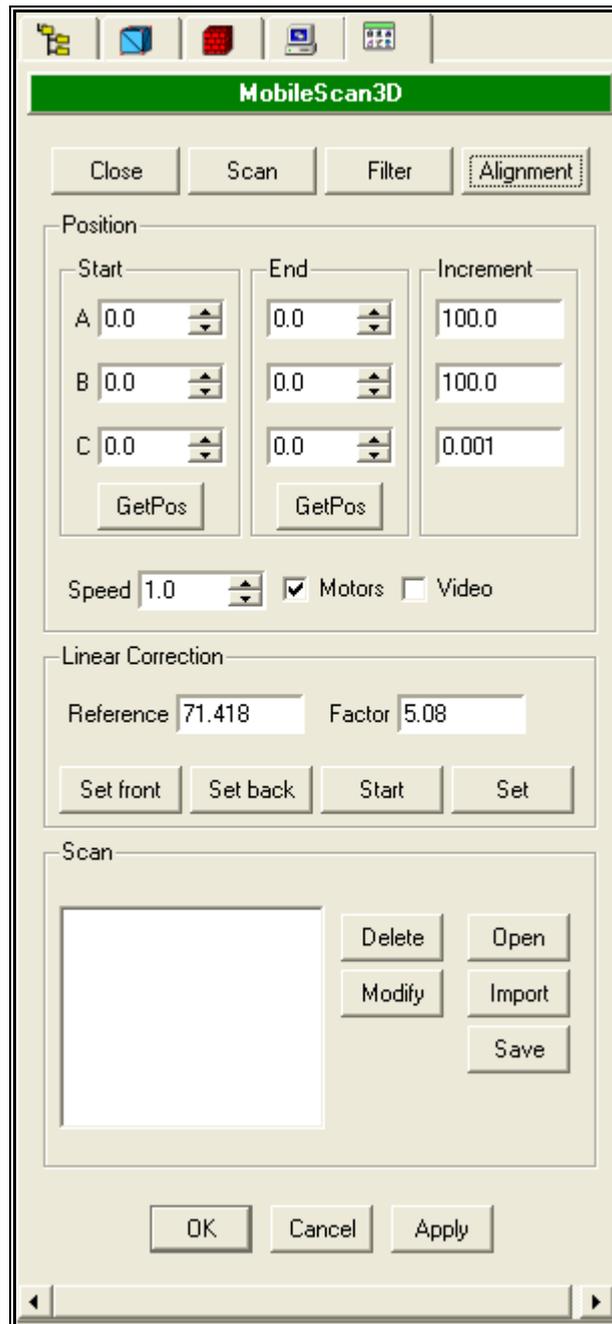Now, the artefact is correctly placed and you may start supplying the needed information for the linear correction.

Figure 23 – Linear Correction Controls

Firstly, in the **[Reference]** field, type the artefacts's reference size. This value is written on the fiberglass part of the artefact. You find this value also in the artefact protocol.

Set the laser line on the top of the front plane. See figure 2

Click **[Set front]**: A scan task named LinCorrFront is added to the scan list.

Set the laser line on the top of the back plane See figure 4

Click **[Set back]**: A scan task named LinCorrBack is added to the scan list.

Click **[Start]**. The linear correction will be done.

When the LinCorr procedure is finished the correction factor is automatically set.

[Set]: In this case, the correction factor is set to the specified value. Used to reset the correction factor to the default value (zero). Not necessary if you have already done the linear correction.

Measuring

Defining a measurement

Before starting defining a measurement assure that:

- The software drivers are correctly installed. See "How to Install the Software Drivers".

- The MobileScan3D software is installed. See How to Install the Software".

- The Plugin for Geomagic is installed. See "Plugin Installation".

- The a-axis calibration was done, if you are using the rotary table. See "A-Axis Adjustment (rotary table)".

Note: For this sample we assume that a rotary table was installed.

Activate the Plugin.

1. Select the wanted configuration and click **[Start]**.

2. Open the video preview by clicking **[Video].**

3. Place the part to measure on the rotary table.

4. Use the **[Position]** controls to position the laser line at middle of the part.

5. Adjust the sensor sensitivity by using **[Sensor]** control panel (Figure 10). Leave the laser power at 100 and adjust the sensor sensitivity. Reduce the sensitivity as long as you can see a clear white line at the video preview. The sensitivity should be as low as possible.

6. Use the **[Position]** control panel to define the start and the end position of your scan. Assure that the laser line is always visible on the video preview during the scan. The right side of the video preview is the beginning of the measurement range, the left side the end.

7. Click **[Add]** to append the defined scan to the list.

8. Click **[Duplic]** to duplicate the defined scan with different A-Axis positions.

9. Select the wanted scan tasks by clicking and using the Shift or Ctrl key on your keyboard.

10. Click **[Scan]** to Start the Scan.

11. When the scan is finished you can pre-process the data in the MobileScan3D Plugin (filtering and AOI options) or close the plugin and start working with the data in Geomagic. To close the plugin, click on **[OK]** or **[Cancel]** button.

12. If you have finished the data acquisition, inactivate MobileScan3D by clicking **[Close]** on the top left corner of the plugin panel.