

User Manual

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ShapeMetriX



BlastMetriX

SMX Normalizer



**User Manual
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1 Introduction

The *SMX Normalizer* is used for scaling a generic 3D model to a metric (scaled one) in a local coordinate system (*Normalizer Mode*). Additionally, the software allows one to rotate a 3D model to an externally determined azimuth and shift the co-ordinates to one known position (*Normalizer Mode with North Correction*). Furthermore, the *Two Range Pole Mode* features scaling, vertically orientating, and north-correcting at the same time using two non-parallel *Range Poles*. Finally, the software offers a procedure for top-down applications, e.g. in the laboratory (*Sample Mode*).

The scaling of a 3D model is an interactive procedure basically done by clicking on clearly visible reference targets. Within the *Normalizer Mode* the software assumes having a vertically installed *Range Pole* somewhere in the images. The *Range Pole* carries two targets whose distance is known.

Attention:

Marking of the *Range Pole* targets in the images is a crucial step for the absolute metric accuracy of the 3D model and thus should be performed carefully.

In previous versions the *Normalizer Mode* and the *North Correction Mode* were two individual modes. For obtaining a north-corrected 3D model it was necessary to execute the *North Correction Mode* after the *Normalizer Mode*. This current version still provides the *Normalizer Mode* as in previous version but provides the new *Normalizer Mode with North Correction*. In the latter mode scaling, vertical orientation, and north correction is done in a single step.

This user manual addresses all topics related to the *SMX Normalizer* i.e. installation, user interfaces, features and operations. Let us know if we can support you, and give us your valuable feedback. Only this way it remains possible to keep the system both, flexible enough for broad usage and sufficiently specific for your applications.

We wish you success with the *SMX Normalizer*.

The Team of 3GSM

Graz, October 2024

2 General

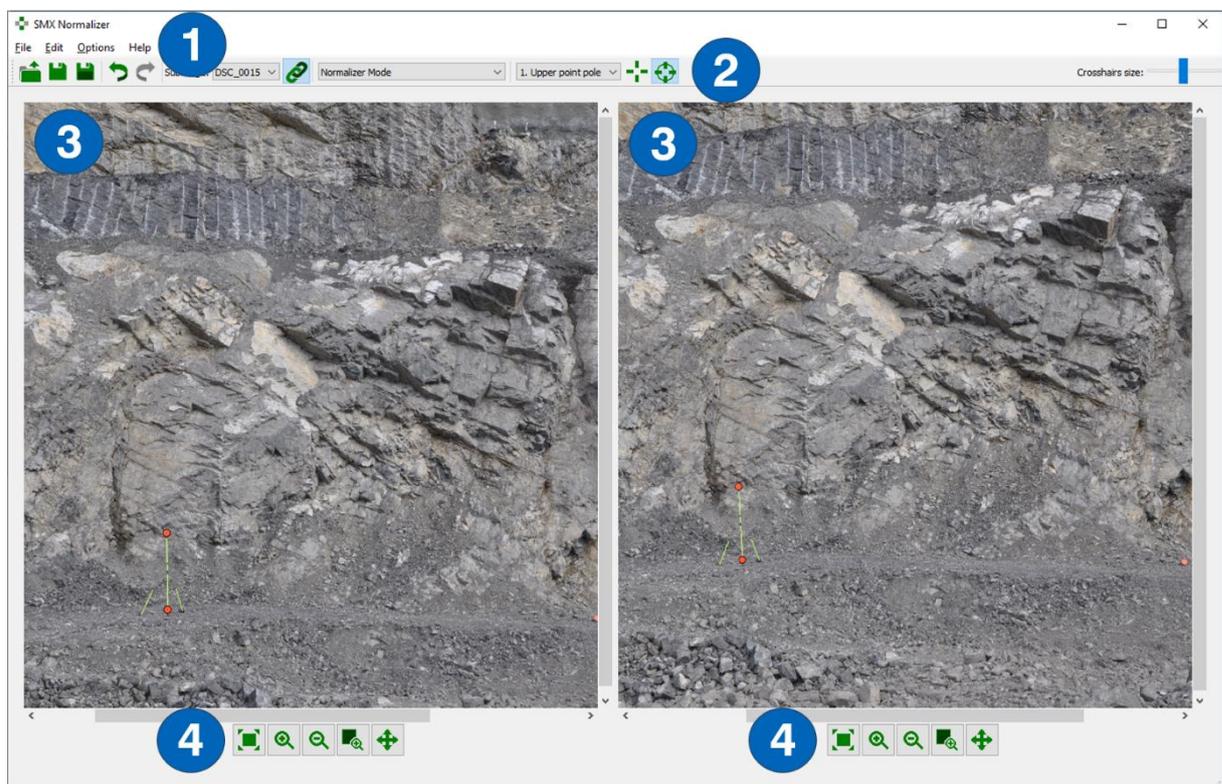
The *SMX Normalizer* is part of the *ShapeMetriX/BlastMetriX* package and not available as a stand-alone program. The installation takes place during the installation of *ShapeMetriX/BlastMetriX* and is described in the corresponding user manual.

Note:

The *SMX Normalizer* software component is used under this name in *ShapeMetriX* and *BlastMetriX* packages, i.e. there is no dedicated *BMX Normalizer*. The same may apply to other software components.

3 User Interface

The user interfaces of the *SMX Normalizer* (Figure 1) comprises the menu bar, the toolbar and the stereo viewers displaying the two photos of a *Stereoscopic Image Pair*.



- 1 Menu bar
 - 2 Toolbar
 - 3 Stereo viewers
 - 4 Toolbar of the stereo viewers
- Figure 1: User interface of the *SMX Normalizer*

4 Features

This section describes the available functions of the *SMX Normalizer*.

4.1 Stereo viewer

The stereo viewers display the two photos of a *Stereoscopic Image Pair* (Figure 1 and Figure 2). Each viewer comprises two scroll bars and a toolbar supporting the image display with following features:

Window fit



Fits the size of the image to the size of the viewer

Zoom in



Zooms into the photo

Zoom out



Zooms out of the photo

Zoom to region



Enables to zoom in and out by using the computer mouse

Move



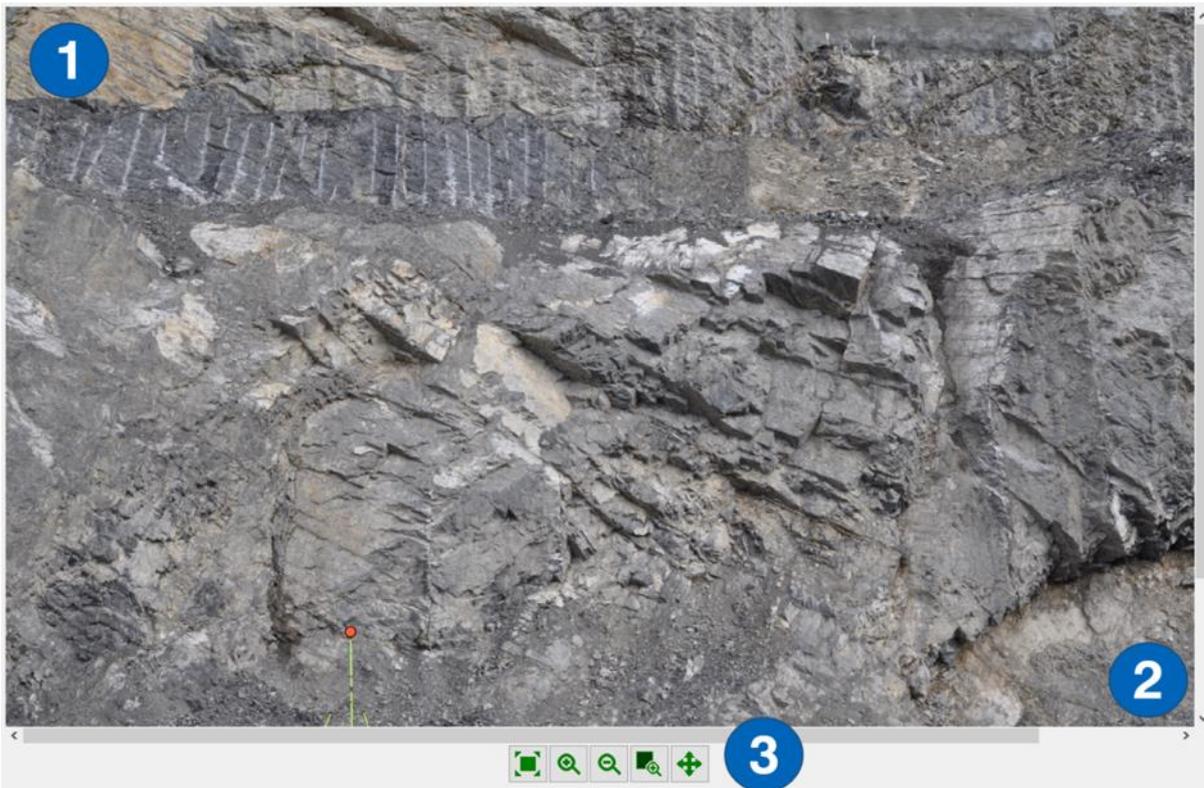
Enables mouse navigation

Hint:

Zooming can also be done using the mouse wheel. Click on middle mouse button zooms in and centres the photograph to the clicked point. In general clicking with the left mouse button performs an action, for instance definition of points.

Hint:

Panning is performed with the horizontal and vertical scroll bars at the bottom and the right hand side of the viewer window.



- 1 Viewer window
- 2 Scroll bar
- 3 Toolbar

Figure 2: Viewer window of the stereo viewer

4.2 Menu bar

File Edit Options Help

The menu bar comprises four main menus. The menu commands are accessible using the mouse cursor. The following paragraphs describe the structure and commands of the four main menus (*File*, *Edit*, *Options* and *Help*).

Menu File

- Open 3D Model* Opens a 3D model (".jm3 file")
- Correct Model and Save* Corrects and saves the 3D model (".jm3" file)
- Correct Model and Save as* Corrects, renames and saves the 3D model (".jm3" file)
- Exit* Closes *SMX Normalizer*

Menu Edit

- Undo* Revokes the previously executed commands step by step
- Redo* Redoes commands revoked by the "Undo" function step by step
- Manual Targeting* Allows manually targeting

<i>Automatic Targeting</i>	Uses automatic targeting
<i>Normalizer Mode</i>	Activates the <i>Normalizer Mode</i>
<i>Normalizer Mode with North Correction</i>	Activates the <i>Normalizer Mode with North Correction</i>
<i>Two Range Poles Mode</i>	Activates the <i>Two Range Poles Mode</i>
<i>Sample Mode</i>	Activates the <i>Sample Mode</i>

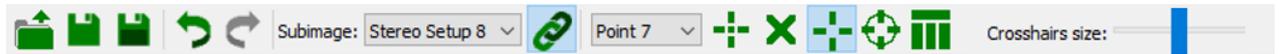
Menu Options

<i>Link Views</i>	Links the motion of the left and the right image of a <i>Stereoscopic Image Pair</i> when navigating (zooming and planning)
<i>Show Images Smoothed</i>	Applies colour interpolation between pixel transitions

Menu Help

<i>User Manual</i>	Opens the manual of the software component
<i>Units</i>	Displays the units used by the software
<i>About</i>	Displays versions and release information of the software component

4.3 Toolbar



Open 3D Model



Opens a 3D model (".jm3" file)

Correct Model and Save



Corrects and saves the 3D model (".jm3" file)

Correct Model and Save as



Corrects, renames and saves the 3D model (".jm3" file)

Undo



Revokes the previously executed commands step by step

Redo



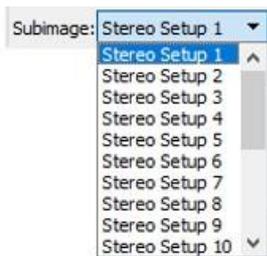
Redoes commands revoked by the “Undo” function step by step

Link Views



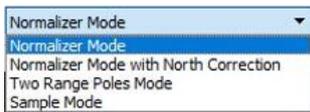
Links the motion of the left and the right image of a *Stereoscopic Image Pair* when navigating (zooming and planning)

Switch Subimages



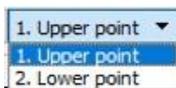
Pull-down menu for switching between subimages (or *Stereo Setups*)

Switch Mode



Pull-down menu for switching between modes

Switch Points



Pull-down menu for switching points

Manual Targeting



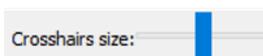
Allows manually targeting

Automatic Targeting



Uses automatic targeting

Crosshair size



Adjusts the size of the crosshair markers in the picture

5 Modes

5.1 Normalizer Mode

The *Normalizer Mode* changes the geometry of the generic 3D model into a metric 3D model. It relies on a vertically installed *Range Pole* with two targets. The distance between targets must be known and serves as the scaling distance (standard configuration distance 2.35 m see Figure 3). For the proper installation of *Range Poles* refer to the *ShapeMetriX* or *BlastMetriX* user manuals.

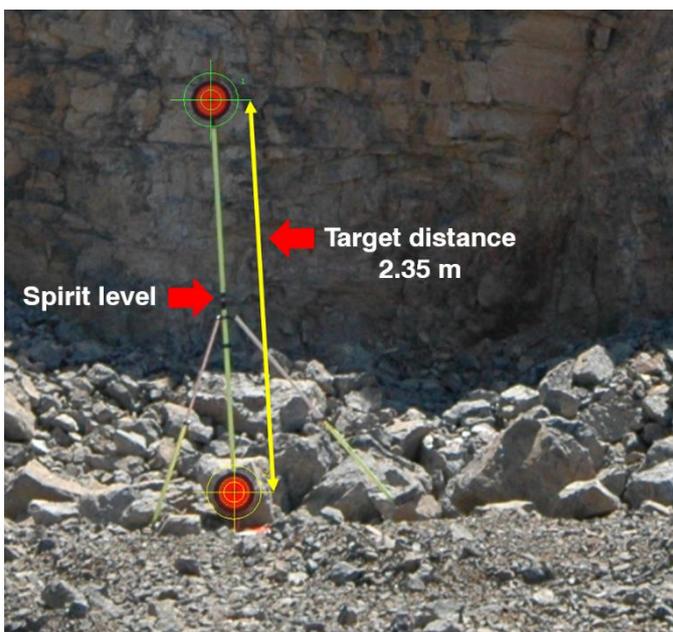


Figure 3: Vertically installed Range Pole with two targets. The target standard distance is 2.35 m. Note that the Range Pole might appear not to be vertical due to tilted camera when taking the picture and/or lens distortion.

The following points have to be defined in the left and right picture of the *Stereoscopic Image Pair* or *Stereo Setup* (see Figure 4):

- Upper point of the *Range Pole* - *Upper Point Pole*
- Lower point of the *Range Pole* - *Lower Point Pole*

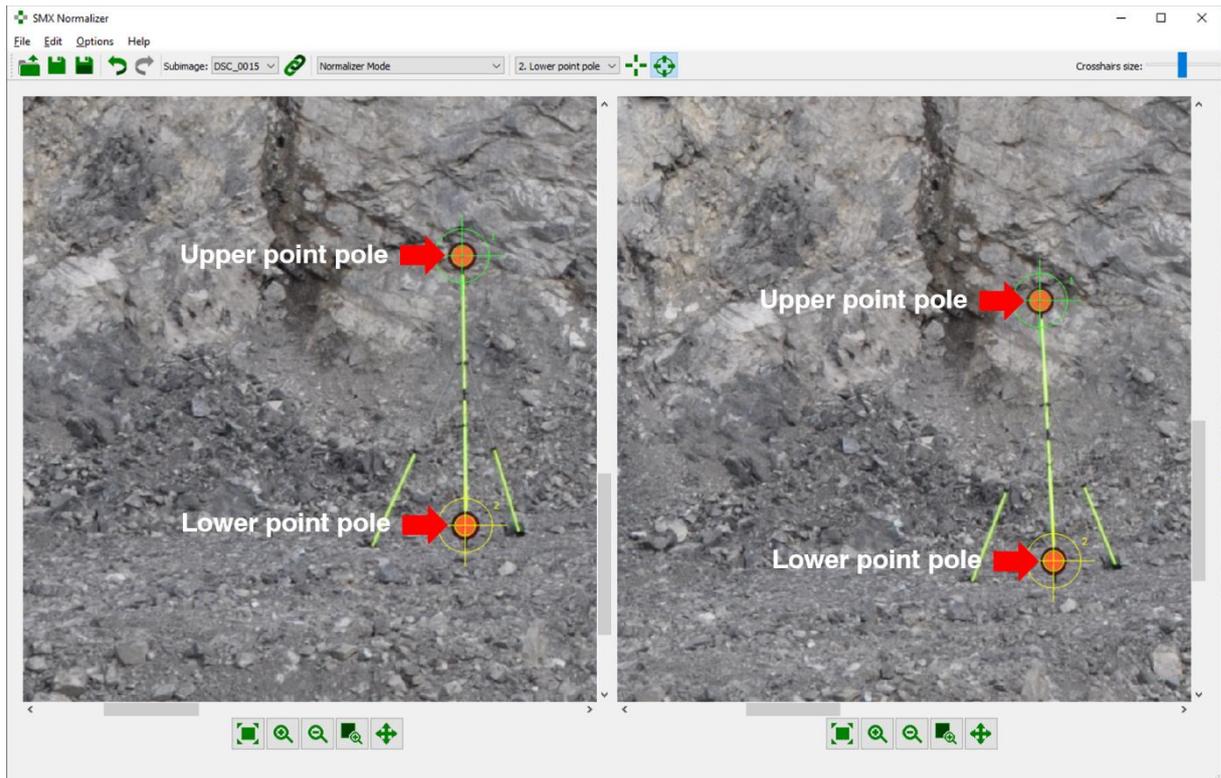


Figure 4: Corresponding Upper Point Pole and Lower Point Pole marked in the left and right image

It is necessary that the *Range Pole* is visible in at least one *Stereoscopic Image Pair* (*SMX ReconstructionAssistant* and/or *SMX ModelMerger*) or one *Stereo Setup* (*SMX MultiPhoto*) within a 3D model (".jm3").

Following the procedure of the *Normalizer Mode*, results in a scaled and vertically aligned 3D model ready for geological evaluations. The 3D model can be orientated to North using the *Normalizer Mode with North Correction* (see Chapter 5.2 below).

5.2 Normalizer Mode with North Correction

The *Normalizer Mode with North Correction* is used to scale and rotate a generic 3D model into its correct vertical and horizontal orientation. It is an extension of the *Normalizer Mode* described in Chapter 5.1.

The rotation of the 3D model about its vertical axis is based on the measured azimuth (geographic direction) of a reference line in the field, the so-called target azimuth. The *Reference Line* in the 3D model is defined by two points called *Start Point Northing* and *End Point Northing* while the direction of the *Reference Line* points from start to the end point (see Figure 5).

Surveyed Control Point

This mode is also used to shift the 3D model to a position in space using a *Surveyed Control Point*. The *Surveyed Control Point* be an artificial target or natural or marked points on the rock face. Co-ordinates (Easting, Northing, Height) must be known for using a *Surveyed Control Point*.

The following points have to be defined in the left and right picture of the *Stereoscopic Image Pair* or *Stereo Setup*:

- Upper point of the *Range Pole* - *Upper Point Pole*
- Lower point of the *Range Pole* - *Lower Point Pole*
- Start point of *Reference Line* - *Start Point Northing*
- End point of *Reference Line* - *End Point Northing*
- *Surveyed Control Point* (optional)

In addition, the *Normalizer Mode with North Correction* requires the input of the target azimuth (Figure 5). Figure 6 and Figure 7 show typical examples of field setups for the *Normalizer Mode with North Correction* using target points and using natural points, respectively.

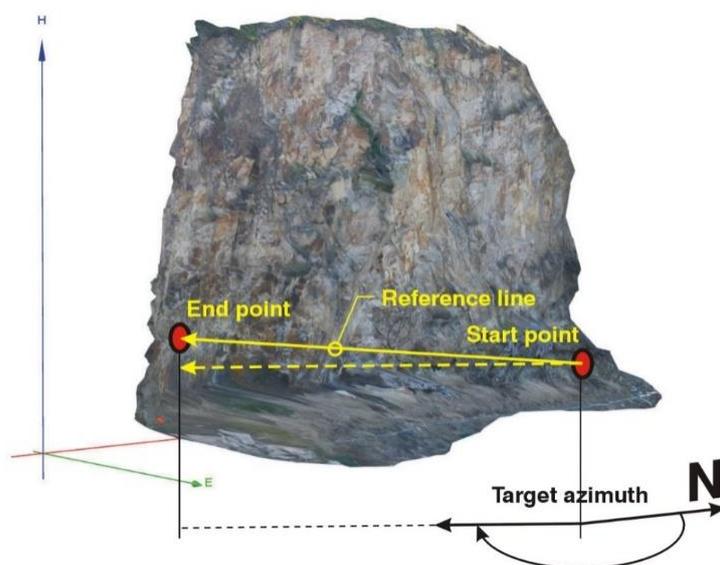


Figure 5: Definition of the target azimuth in the Normalizer Mode with North Correction. The target azimuth is the direction of the horizontal projection (dashed line) of the Reference Line from start point to end point relative to north.

Note:

The target azimuth is equal to the geographic direction of the *Reference Line* (azimuth of the *Reference Line*; Figure 14) relative to north.

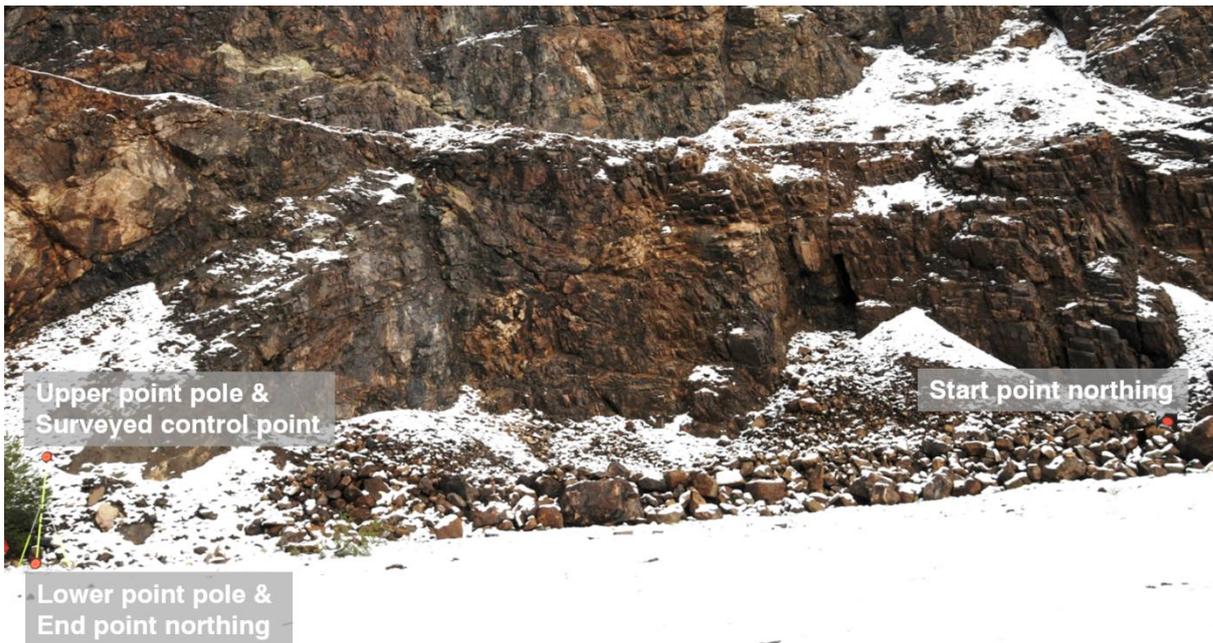


Figure 6: Using targets: Stereoscopic Image Pair with defined reference line from Start Point Northing (= an additional target or marker) to End Point Northing (= the lower point of the Range Pole). A Surveyed Control Point has also been defined (e.g. upper point of Range Pole). Note that the Surveyed Control Point is optional in the Normalizer Mode with North Correction.

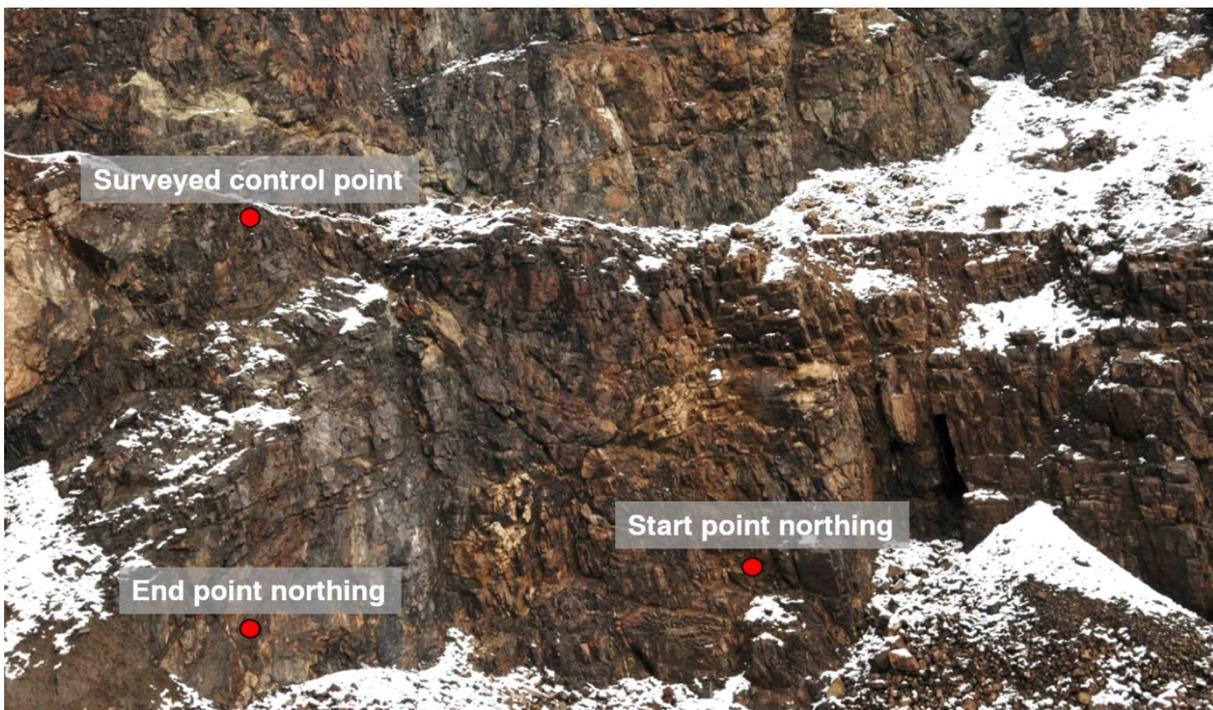


Figure 7: Using natural points: Stereoscopic Image Pair with defined reference line (from Start Point Northing to End Point Northing and Surveyed Control Point on the rock face). The points have to be accurately defined in the images. Note that the Surveyed Control Point is optional in the Normalizer Mode with North Correction.

5.3 Two Range Poles Mode

The *Two Range Pole Mode* features scaling, vertically orientating, and north-correcting at the same time using **two non-parallel Range Poles** visible in the photos (Figure 8). This mode requires as input the distance between the *Range Pole* targets and the trend and plunge of the two *Range Poles*. It is possible to have the same target distances for both, *Range Poles* or different target distances, for each of the *Range Poles*. The trend and plunge of the *Range Poles* have to be determined in the field, e.g. using a geologic compass (Clar or Brunton). Optionally, the co-ordinates of a *Surveyed Control Point* can be defined.

Surveyed Control Point

This mode is also used to shift the 3D model to a position in space using a *Surveyed Control Point* can. The *Control Point* might be an artificial target or natural or marked points on the rock face. Co-ordinates (Easting, Northing, Height) must be known for using a *Surveyed Control Point* can.

The following points have to be defined in the left and right picture of the *Stereoscopic Image Pair* or *Stereo Setup*:

- Upper point of the first *Range Pole* - *Upper Point First Pole*
- Lower point of the first *Range Pole* - *Lower Point First Pole*
- Upper point of the second *Range Pole* - *Upper Point Second Pole*
- Lower point of the second *Range Pole* - *Lower Point Second Pole*
- *Surveyed Control Point* (optional)

In addition, the *Two Range Poles Mode* requires the input of the trend and the plunge of both *Range Poles* and the target distances.



- 1 *Range Pole* target distance
- 2 Trend of *Range Poles*
- 3 Plunge of *Range Poles*

Figure 8: Functional principle of the *Two Range Poles Mode*

5.4 Sample Mode

The *Sample Mode* is used to define a local co-ordinate system with a horizontal reference plane. This is especially suitable for registering laboratory samples. The mode requires defining three points, two points provide scale and orientation of the X axis while the third point defines the XY plane. For standardised applications a reference object is available through 3GSM.

The *Sample Mode* is based in a right handed co-ordinate system and requires the definition of three points; i.e. *First Point*, *Second Point* and *Plane Point*. The local co-ordinate system is defined as follows:

- The x-axis points from the *Second Point* to the *First Point*.
- The *Plane Point* defines the orientation of the xy-plane by fixing the orientation around the x-axis.
- The y-axis points from the *Plane Point* into the direction of the x-axis.
- The z-direction is either to the observer or away from the observer, respectively, depending from orientation of the other axis

In addition, the *Sample Mode* requires the input of the point distance between the *First* and the *Second Point*. According to the setup of the three points four scenarios of co-ordinate system are possible (see Figure 9).

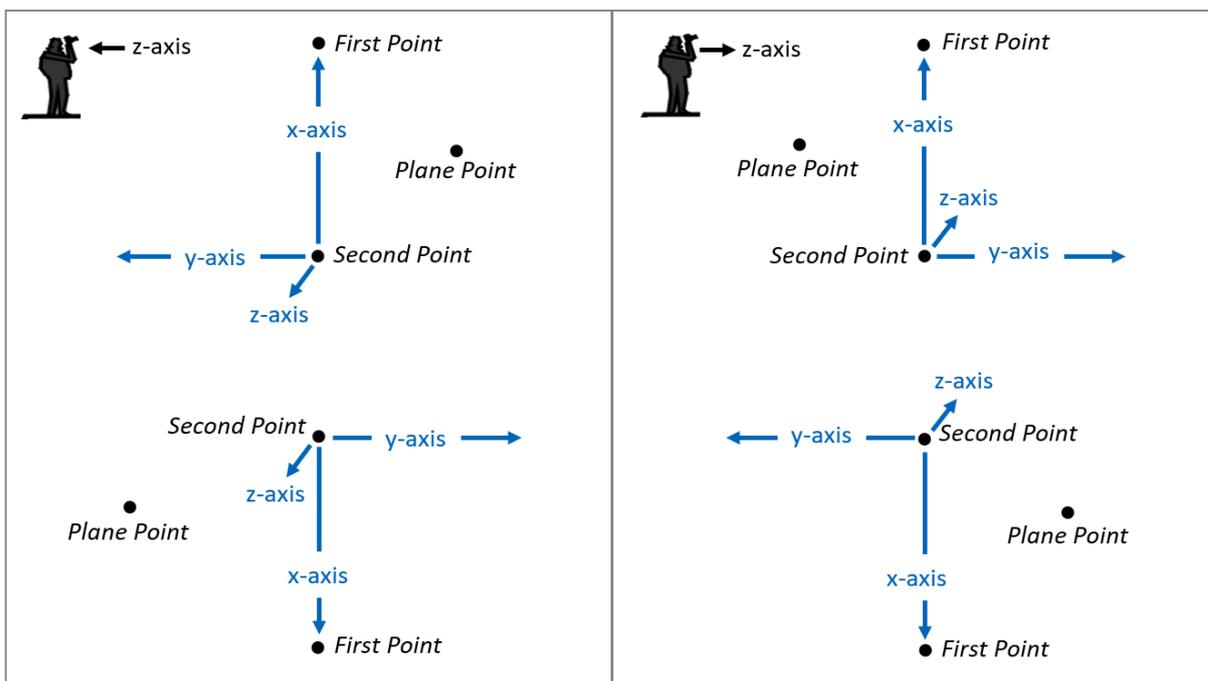


Figure 9: Orientation possibilities of the *Sample Mode* as a result of the marker setup

Figure 10, Figure 11 and Figure 12 show definitions of natural *Reference Points* using manual targeting and standardised reference object using automatic targeting, respectively.

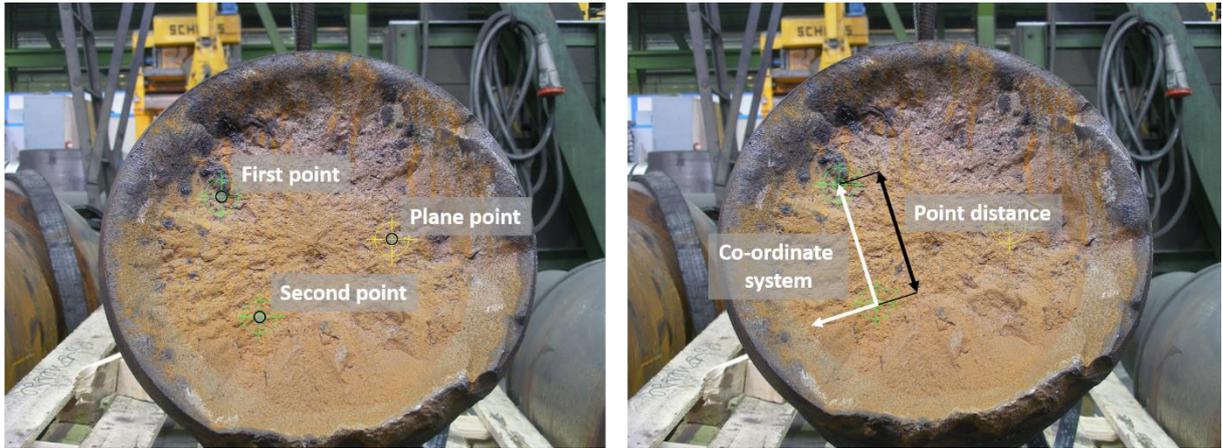


Figure 10: Definition of the Reference Points in the Sample Mode and local co-ordinate system using natural Reference Points

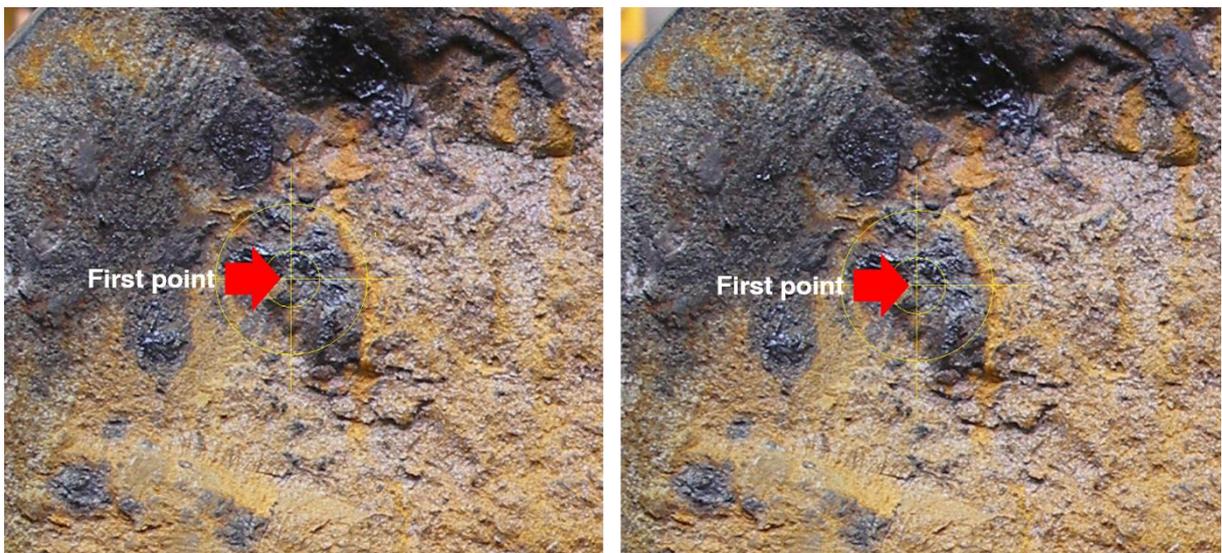


Figure 11: Definition of natural Reference Points using manual targeting

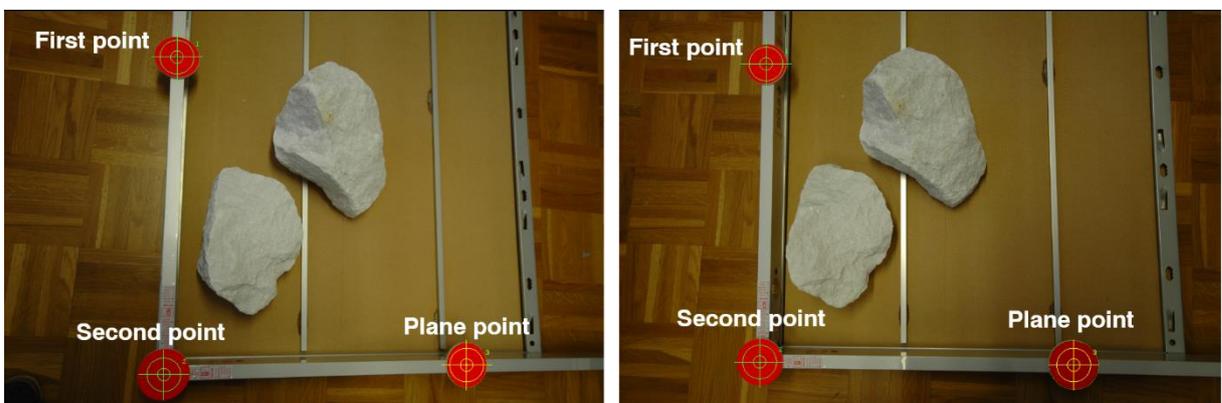


Figure 12: Definition of Reference Points with automatic targeting using a standardised reference object with targets and spirit levels. For the design of reference figures contact 3GSM

6 Standard operation procedure

Hint:

Check if the two image views are clamped to each other (icon  sunken). If yes, zooming and panning is performed on both images simultaneously.

Hint:

Colour codes of the reticule:

yellow: reticule active

green: marker set

6.1 Normalizer Mode

1. Load a (generic) 3D model as resulting from the *SMX ReconstructionAssistant*, *SMX ModelMerger* or *SMX MultiPhoto* by clicking “*File | Open 3D Model*” or use the according icon () and choosing the intended file with extension “.jm3”. The *Stereoscopic Image Pairs* of the 3D model appear.
2. Check if the two image views are clamped to each other (icon  sunken).
3. Select “*Normalizer Mode*” from the pull down menu “*Switch Mode*” in the toolbar or “*Edit | Normalizer mode*” from the menu bar.
4. Select the *Stereoscopic Image Pair* or *Stereo Setup* which shows the *Range Pole* from the pull down menu “*Switch Subimages*”.
5. Select “*Upper Point Pole*” in the pull down menu “*Switch Points*”.
6. Zoom the images in a way that the upper target disc (*Upper Point Pole*) of the *Range Pole* is shown clearly in the left image view.
7. Choose automatic or manual targeting by choosing either “*Edit | Automatic Targeting*” or “*Edit | Manual Targeting*” from the main menu or use the corresponding icons ( or ). Automatic targeting is recommended if standardised reference target at a sufficiently large size are used. In other cases manual targeting should be used (small reference targets or natural *Reference Points*). A detailed description for targeting is found in Chapter 6.5.
8. Click with the left mouse button into the center of the target disc. Check either the plausibility of the identified center (automatic targeting) or check the accuracy of centering (manual targeting).
9. Define the center of the targets in the left and right image.
10. Repeat 4 – 9 for the *Lower Point Pole* (lower target disc of the *Range Pole*). Figure 4 shows an example of automatically targeting of a *Range Poles* in the stereo viewer.
11. Save the result by clicking “*File | Correct Model and Save*” or “*File | Correct Model and Save as*” in the main menu or clicking the corresponding icons ( or , respectively).

12. A dialog window appears (Figure 13) after clicking the “Save” button. Check the preset target distance (point distance). The preset value is 2.35 m which corresponds to the standard *Range Pole* assembly suggested. If, for any reason, another assembly has been used, the distance value has to be adjusted to the used target distance. Enter the used target distance in the set unit.

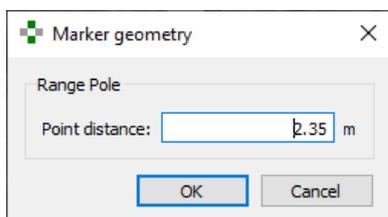


Figure 13: Dialog for the input of the target distance for the Normalizer Mode.

Hint:

As long as not all required points are marked the generic 3D model cannot be saved.

6.2 Normalizer Mode with North Correction

1. Load a (generic) 3D model as resulting from the *SMX ReconstructionAssistant*, *SMX ModelMerger* or *SMX MultiPhoto* by clicking “File | Open 3D Model” or use the according icon  and choosing the intended file with extension “.jm3”. The *Stereoscopic Image Pairs* of the 3D model appear.
2. Check if the two image views are clamped to each other (icon  sunken).
3. Select “Normalizer Mode with North Correction” from pull down menu “Switch Mode” in the toolbar or “Edit | Normalizer Mode with North Correction” from the menu bar.
4. Follow the steps 4 – 10 in Chapter 6.1 to set “Upper Point Pole” and “Lower Point Pole”
5. Select the *Stereoscopic Image Pair* or *Stereo Setup* which shows the start point of the *Reference Line* from the pull down menu “Switch Subimages”.
6. Zoom the images in a way that the start point of the *Reference Line* is shown clearly in the left image view.
7. Select “Start Point Northing” in the points’ pull down menu.
8. Define the start point of the *Reference Line* in the left and right image either by automatic targeting or manual targeting.
9. Repeat steps 5 – 8 for the end point of the *Reference Line* (*End Point Northing*).
10. If co-ordinates of an additional *Control Point* are available, select “Surveyed Control Point” in the pull down menu “Switch Points” and repeat steps 5 – 9. Note that the *Control Point* can be one of the points defining the *Reference Line*.

11. Save the result by clicking “File | Correct Model and Save” or “File | Correct Model and Save as” in the main menu or clicking the corresponding icons ( or , respectively).
12. A dialog window appears (Figure 14) after clicking the “Save” button. Check the preset target distance in the appearing dialog (see step 11 in Chapter 6.1). In addition, the software requires the input of the azimuth of the reference line and, if defined, the co-ordinates of the *Surveyed Control Point*. The fields for the *Control Point* co-ordinates are only active if a *Control Point* has been defined in the pictures.

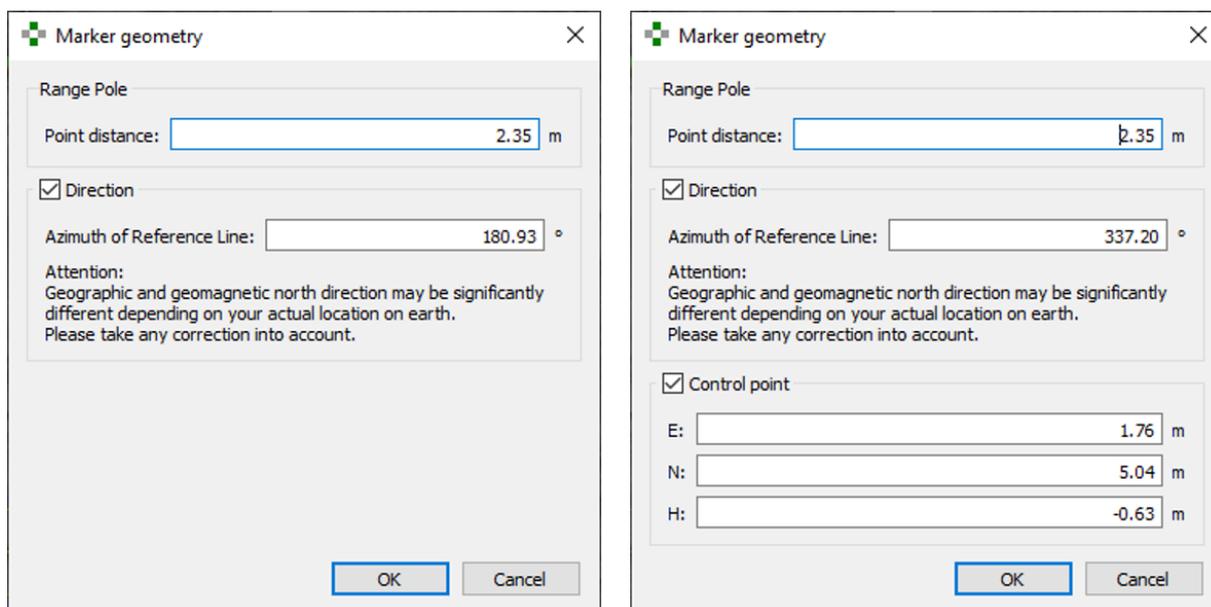


Figure 14: Dialog for the marker geometry in the “Normalizer Mode with North Correction” without (left) and optionally with a marked *Surveyed Control Point* (right)

6.3 Two Range Poles Mode

1. Load a (generic) 3D model as resulting from the *SMX ReconstructionAssistant*, *SMX ModelMerger* or *SMX MultiPhoto* by clicking “File | Open 3D Model” or use the according icon () and choosing the intended file with extension “.jm3”. The *Stereoscopic Image Pairs* of the 3D model appear.
2. Check if the two image views are clamped to each other (icon  sunken).
3. Select “Two Range Poles Mode” from pull down menu “Switch Mode” in the toolbar or “Edit | Two Range Poles Mode” from the menu bar.
4. Follow the steps 4 – 9 in Chapter 6.1 to set “Upper Point First Pole, Lower Point First Pole, Upper Point Second Pole and Lower Point Second Pole.
5. If co-ordinates of a *Surveyed Control Point* are available, repeat steps 5 – 9 in Chapter 6.2 to set the point.
6. Save the result by clicking “File | Correct Model and Save” or “File | Correct Model and Save as” in the main menu or clicking the corresponding icons ( or , respectively).

7. A dialog window appears (Figure 15) after clicking the “Save” button. Check the preset target distance (point distance) in the appearing dialog (see step 11 in Chapter 6.1). In addition, the software requires the input of the trend and plunge of both *Range Poles* and the target distance. If two different target distances are used, the check box “Enable alternative point distance” has to be enabled. The fields for the *Control Point* co-ordinates are only active if a *Control Point* has been defined in the pictures.

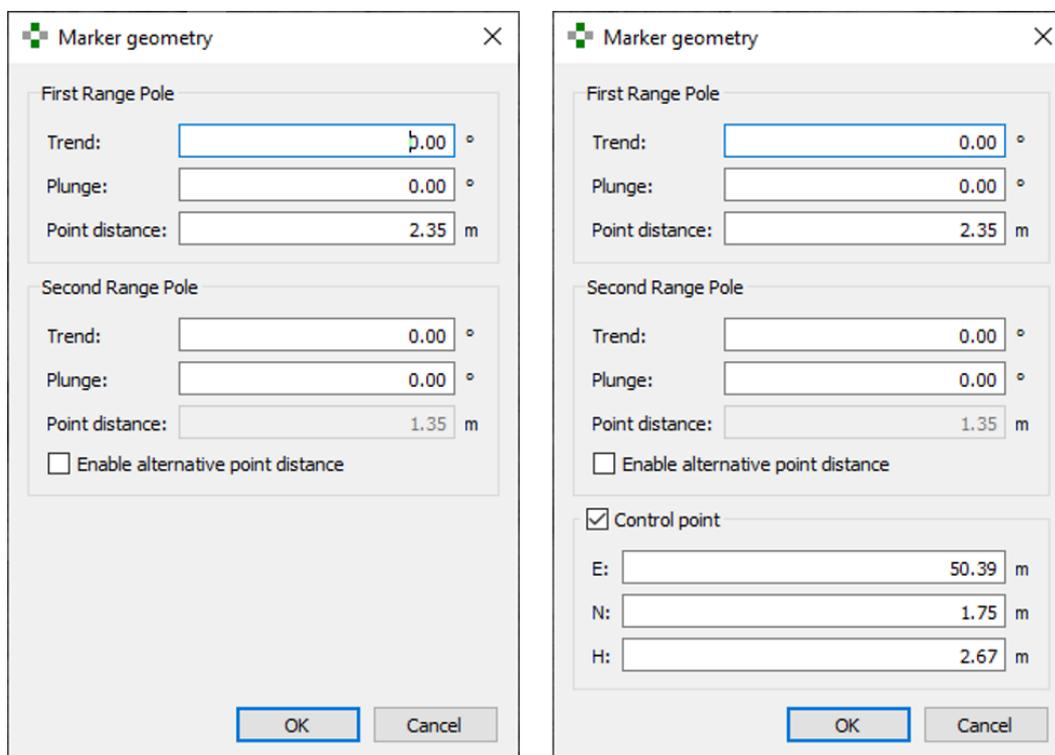


Figure 15: Dialog for the marker geometry in the Two Range Poles Mode without (left) and optionally with a marked Surveyed Control Point (right).

6.4 Sample Mode

1. Load a (generic) 3D model as resulting from the *SMX ReconstructionAssistant*, *SMX ModelMerger* or *SMX MultiPhoto* by clicking “File | Open 3D Model” or use the according icon  and choosing the intended file with extension “.jm3”. The *Stereoscopic Image Pairs* of the 3D model appear.
2. Check if the two image views are clamped to each other (icon  sunken).
3. Select “Sample Mode” from pull down menu “Switch Mode” in the toolbar or “Edit | Sample Mode” from the menu bar.
4. Select the *Stereoscopic Image Pair* or *Stereo Setup* which shows the corresponding point from the pull down menu “Switch Subimages”.
5. Define the *First Point* and the *Second Point* of the scale bar and additionally the *Plane Point* by following the steps 4 – 9 in Chapter 6.1 (follow the sequence for setting the *Upper Point Pole*). See Figure 10 for an example.

6. Save the result by clicking “File | Correct Model and Save” or “File | Correct Model and Save as” in the main menu or clicking the corresponding icons ( or , respectively). A dialog window appears. Enter the distance between the *First Point* and the *Second Point* in the set unit.

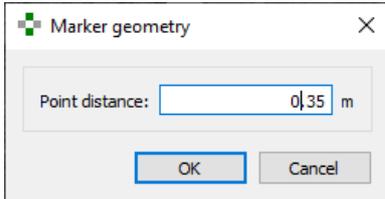


Figure 16: Dialog for the input of the point distance for the Sample Mode

6.5 Targeting

Hint:

Menu “Option | Show Image Smoothed”: If this function is turned on, colour interpolations between pixels transitions is applied. If it is turned off, the pure pixels are displayed. Switching between these two modes may sometimes ease the manual targeting.

Automatic targeting

- a. Activate the “Automatic Targeting” button () or select “Edit | Automatic Targeting” from the main menu.
- b. Click with the left mouse button somewhere within the *Control Point*. If the automatic centering was successful, a reticule appears indicating the center of the target. If the reference target is too small or automatic centring failed, a warning or error message appears, respectively.
- c. Check the identified center for plausibility. For assistance, the identified target boundary is displayed as a dashed line (Figure 17).

Hint:

The automatic targeting works reliably only if the entire disc is visible and the image of the disc is sufficiently large (diameter about 8 pixels) and contrasting from the surrounding. If for any reason the identified center is not reasonable or the automatic targeting fails, the manual targeting mode () can be activated anytime.



Figure 17: Automatic targeting places the reticule in the center of the ellipse represented by the dashed green line. This ellipse is the boundary of the target disc. Its shape must be checked for plausibility.

Manual targeting

- Activate the “Manual Targeting” button () or select “Edit | Manual Targeting” from the main menu.
- Click into the center of the *Control Point*. A reticule appears indicating the manually defined center of the *Control Point*.
- Adapt the size of the reticule according to the current zoom level which supports to identify the center correctly.
- Check the accuracy of the centering in two directions by changing the size of the reticule (Figure 18). This is especially important if the circular targets appear as ellipses.

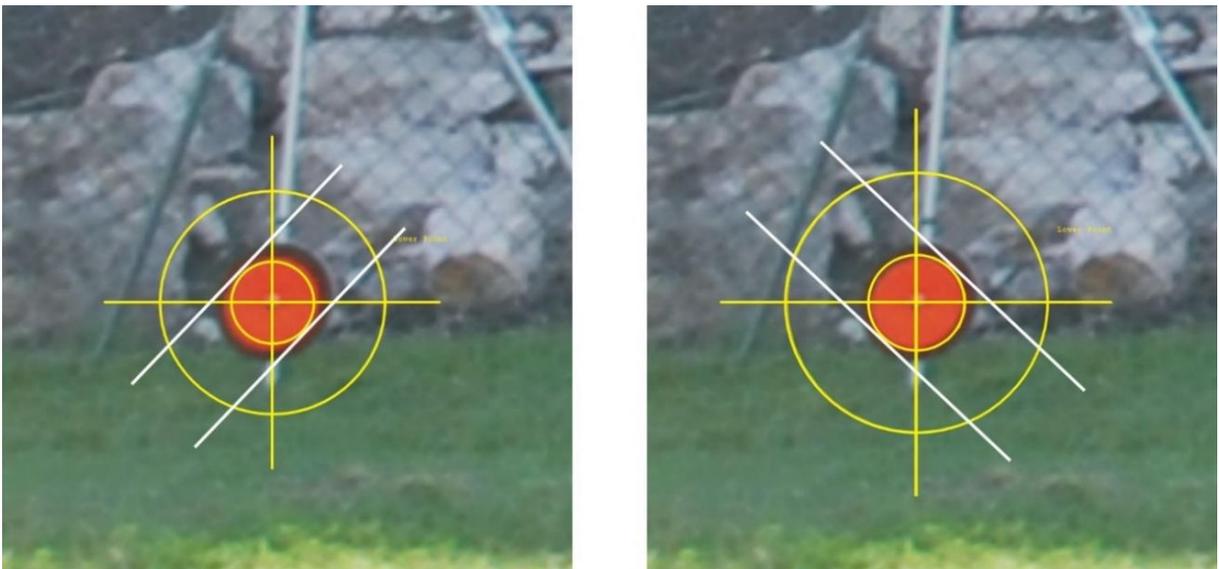


Figure 18: For locating the target discs the image should be zoomed as much as reasonable for visual interpretation. Check the position of the center by changing the size of the reticule. The reticule is well-centered if the circles touch the target’s boundary simultaneously at two opposing points and in two perpendicular directions.

Examples for targeting

The following figures (Figure 19, Figure 20 and Figure 21) show examples automatic and manual targeting.

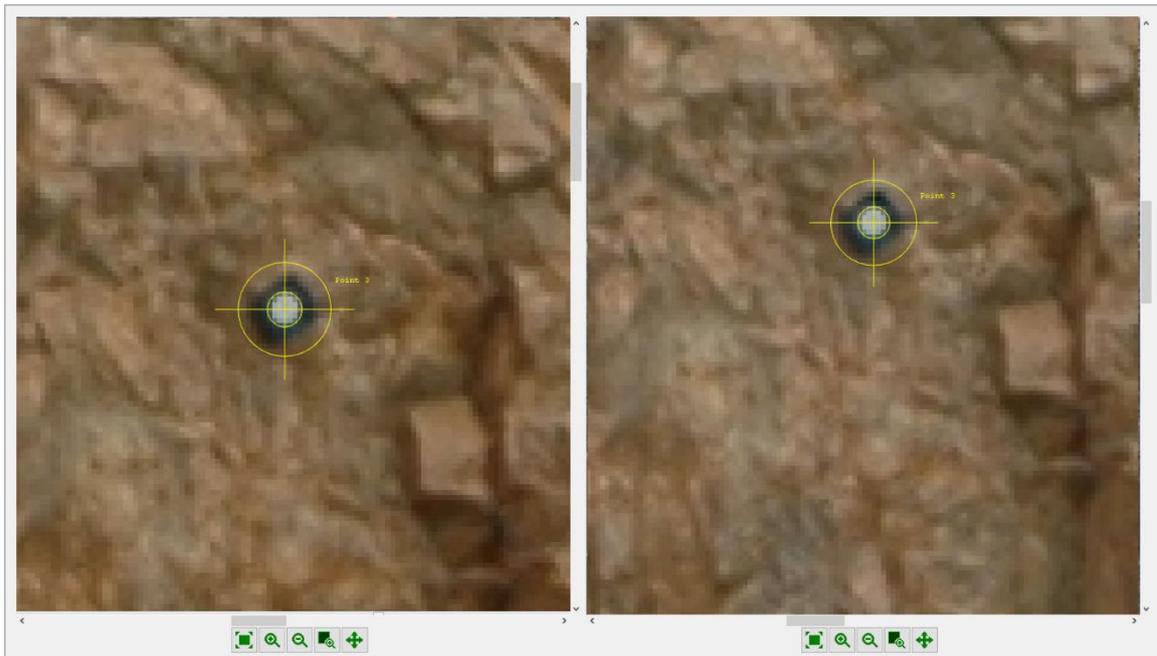


Figure 19: Definition of a Control Point. Automatic targeting is possible but delivers an insecure result as target is too small. Manual targeting is recommended.

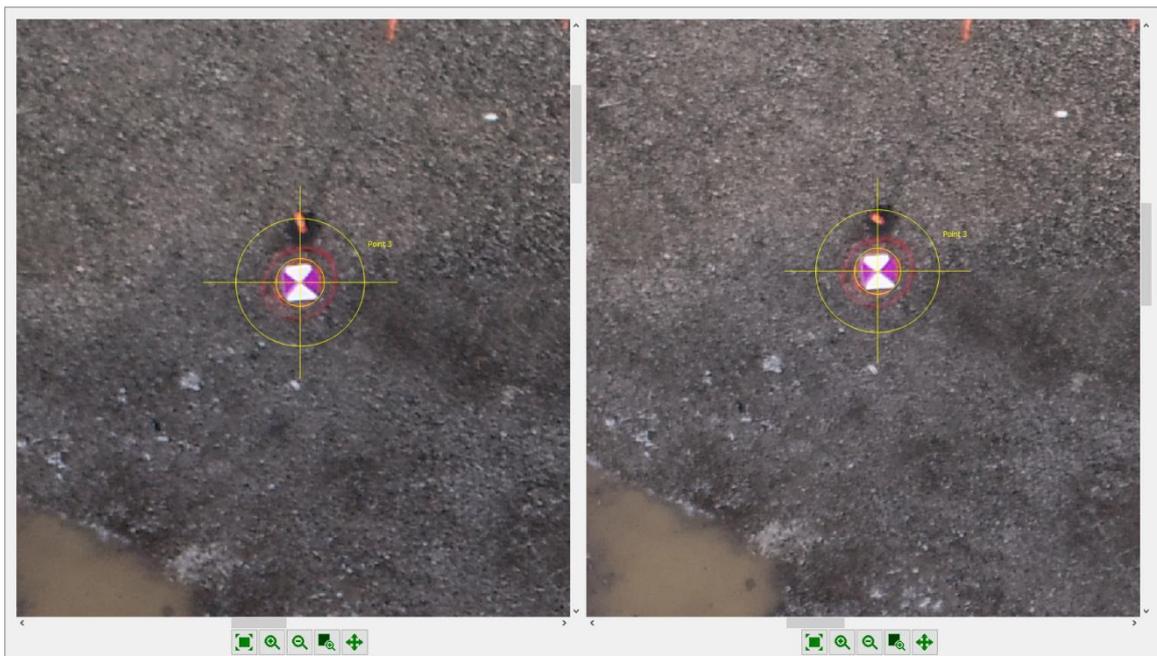


Figure 20: Definition of a Control Point. Automatic targeting is not possible. Reference target has not a shape adequate for automatic targeting. Manual targeting is required.

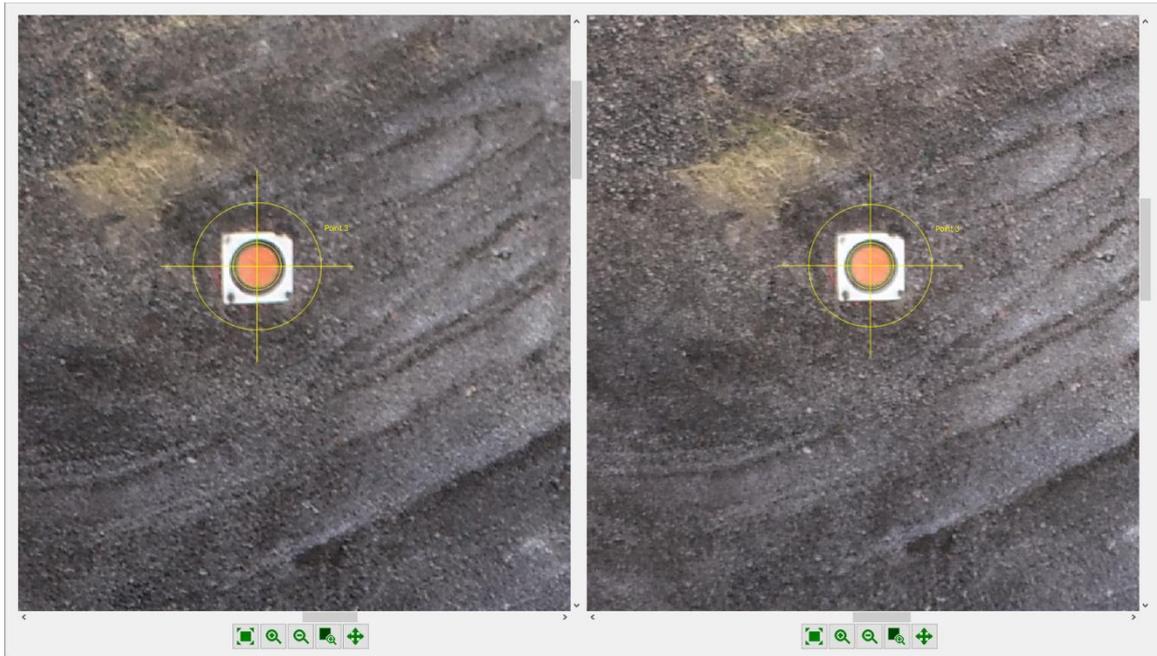


Figure 21: Definition of a Control Point. Automatic targeting is recommended. Reference target has an adequate size and shape for automatic targeting.