VIOSO CALIBRATOR

Autocalibration Software

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english version

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1. Camera-based Multi Display Setup

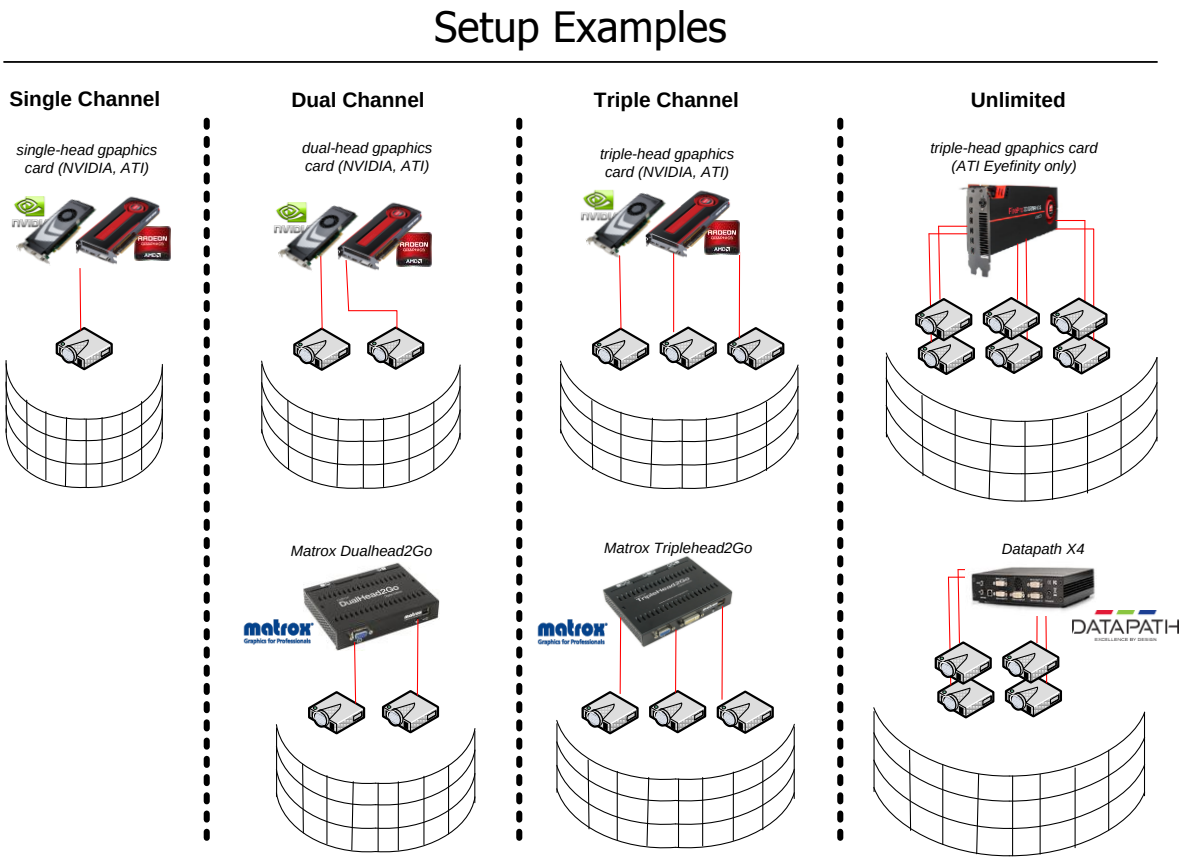
VIOSO Calibrator™ allows you to set up a projection out of multiple displays and to use this result in various products (e.g. Wings VIOSO, VIOSO Anyblend, VIOSO Player). *VIOSO Calibrator*™ is able to identify the position and overlap of the projectors and blends them to create a big single display.

1.1 Hardware setup for single PCs

This section contains all required information regarding the setup and configuration of the camera and projectors. Tips for optimum camera setup are also included.

PC Setup

In order to begin projecting or carrying out automatic image correction, all required components (notebook / PC, projectors and camera if applicable) must be connected properly and the software must be installed.



Projector Setup

Ensure all projectors are properly connected to your PC. Focus the projectors onto the desired projection surface. The projection should be as clear as possible, and the brightness of the surroundings should be adapted according to the light output of the projectors.

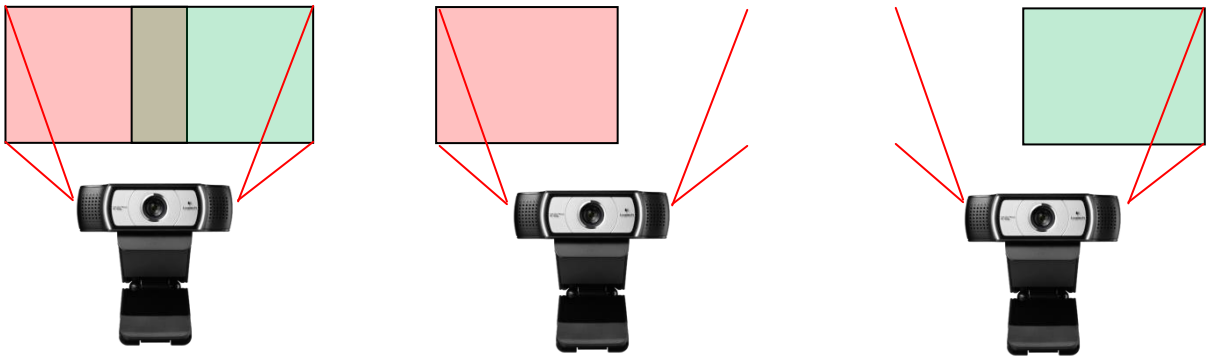
Ensure that the projectors are set up so they are stable, since they should not be moved during and after calibration.

The required projector overlap depends on various parameters. As a rule of thumb, consider an overlap not lower than 10% of each pprojector's edge. An overlap greater than 25% should be avoided, since too much pixels and brightness are lost by such huge overlaps.

Camera Setup

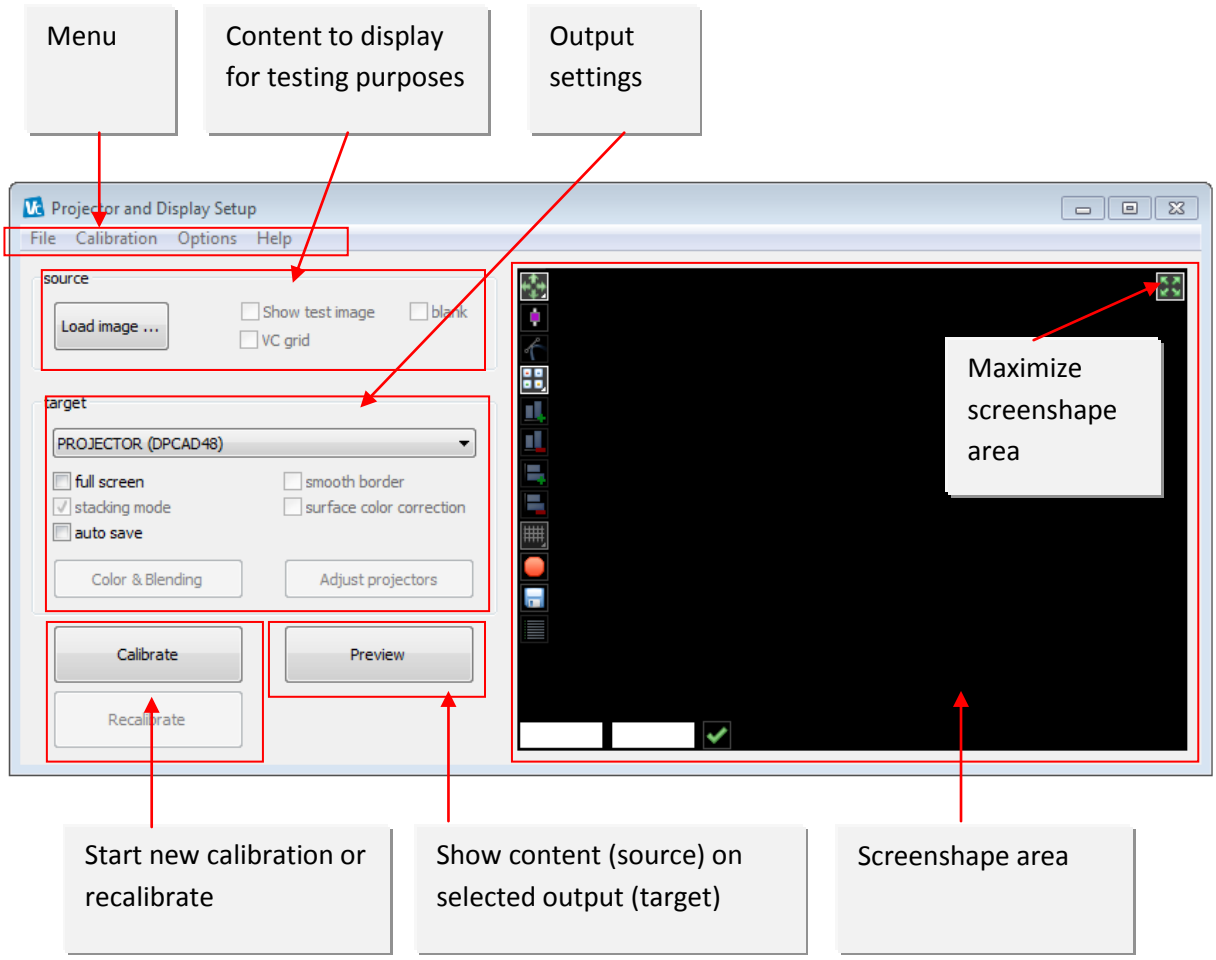
Connect the camera with the PC and make sure that it's signal is detected via the "DirectShow" interface. Use the tool "DirectShow Tester (AMCap)" which comes with this software.

Place the camera to a position so that the total projection screen (with all projectors' images on it) viewed totally by the camera picture.



The camera must capture the whole scenery and is not allowed to move during the calibration of all projectors

2. Main User Interface



3. Fundamentals

3.1 Available calibration methods

There are several methods available to do a multi projector setup:

a) Flat screen / fast scanning: Camera-based method for flat screens and slightly curved screens. Is quite robust regarding the camera image quality and generates the best blending quality on flat screens.

b) Curved screen / fast scanning: Camera-based method for any kind of curved screens, spherical screens and domes. Is quite robust regarding the camera image quality and generates the best blending quality on this kind of screens.

c) Any surface / detailed scanning: Camera-based method for any kind of uneven and complex surfaces. Required a very clear image of the testing patterns filmed by the camera. Requires quite long time for scanning and is intended for experienced users.

d) Manual setup without using a camera Uses an advanced method for manually aligning projectors, getting to a result that is similar to what you get from a camera-based setup.

e) Calculate blending based on a previous calibration: Available if a previous calibration was done successfully or if a calibration is loaded. Allows to do a quick recalibration (camera-based) or to adjust a manual calibration.

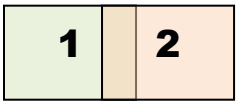
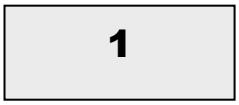
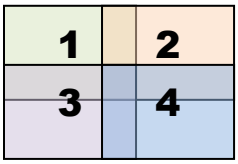
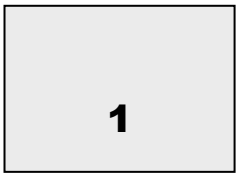
3.2 Screen Split support

Some multihead graphics cards allow the combination of distinct displays to one entire display so that the Windows desktop is spanned over all outputs. The look and native behavior of all programs is adapted on the dimension of the entire display (e.g. a maximized window is covering entire desktop).

This feature is not supported by all graphics cards and is called different by each manufacturer:

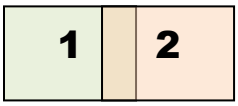
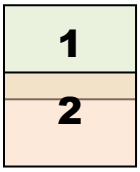
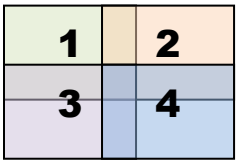
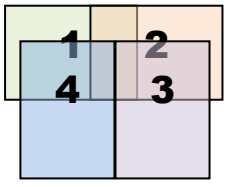
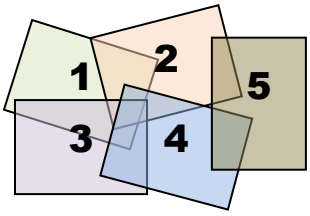
Manufacturer	Product	Creating an entire Desktop	
NVIDIA	GeForce	✓	Supported as „Surround“
	Quadro	✓	supported as „Mosaic“
AMD	Radeon	✓	supported as „Eyefinity Display Group“
	FirePro	✓	
Matrox	Dualhead2Go	✓	Emulates a singular „big“ display
	Triplehead2Go	✓	
Datapath	X4	✓	Emulates a singular „big“ display

Examples:

Projector alignment	Windows desktop	Split setting
		horizontal parts = 2 vertical parts = 1
		horizontal parts = 2 vertical parts = 2

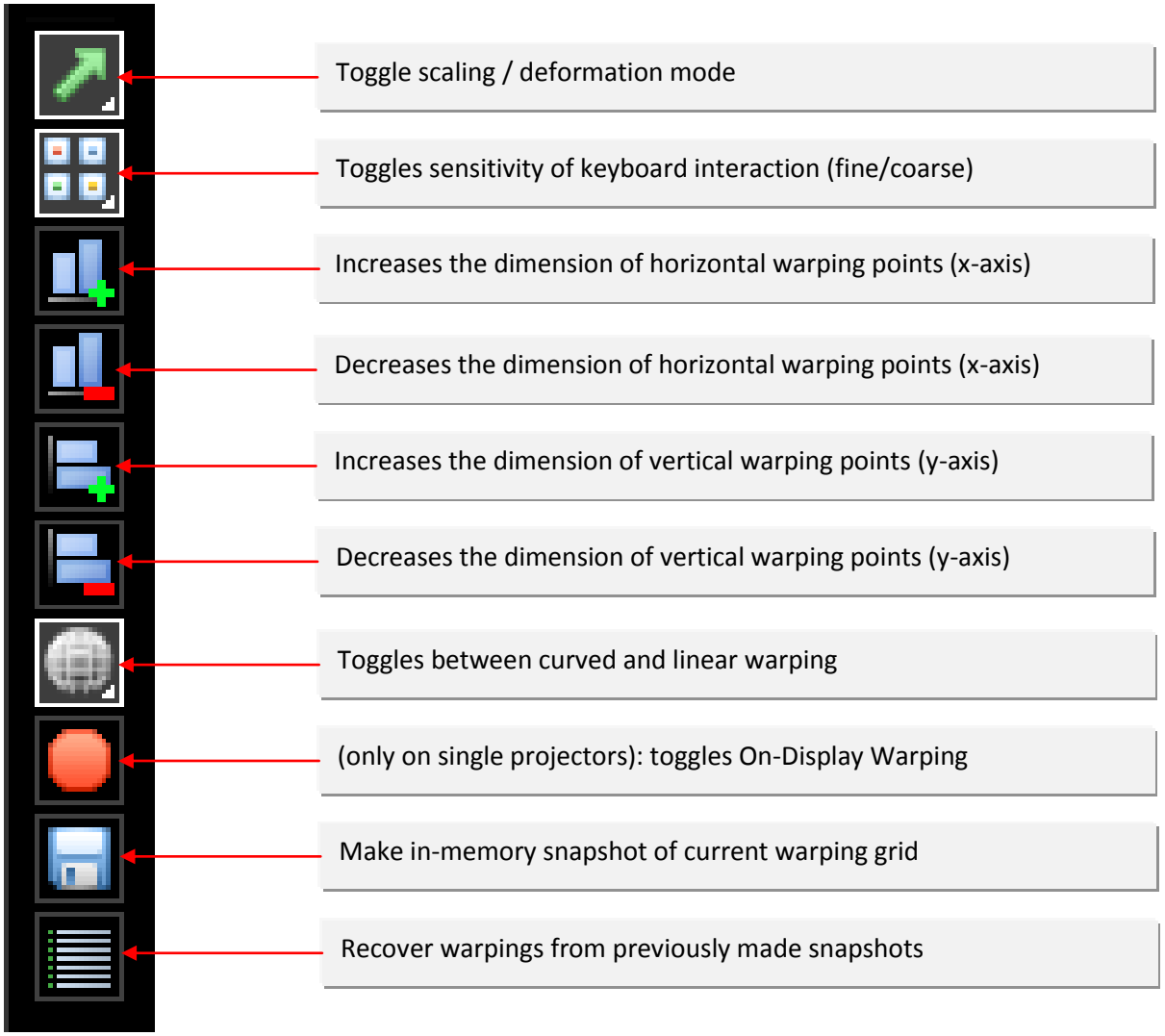
3.3 Arbitrary projector alignments

All kinds of projector alignments are supported:

Projector alignment	Choose during calibration
	“Horizontal Strip” “Autodetect strip arrangement”
	“Vertical Strip” “Autodetect strip arrangement”
	“ Grid/Arbitrary arrangement”
	“ Grid/Arbitrary arrangement”
	“ Grid/Arbitrary arrangement”

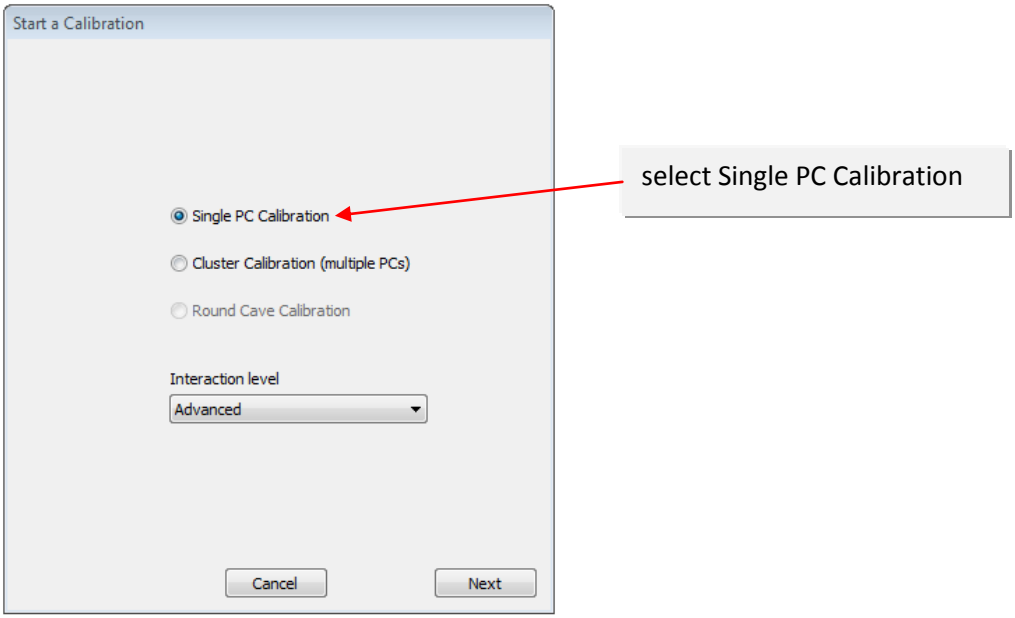
3.4 Infinite display warping capabilities

The warping capabilities are available at several occasions during a single- or multiple projector setup. It is configured by a set of easy to handle tools:



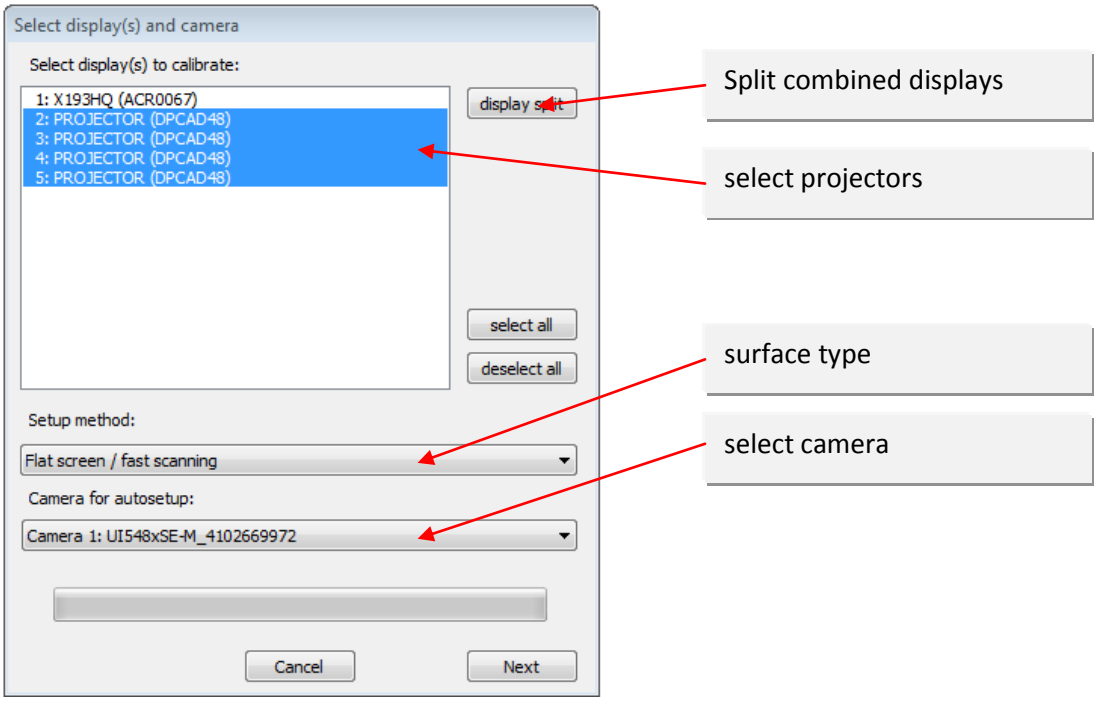
4. Executing a camera-based setup on a single PC

Make sure that camera and projectors are connected and fully functional. Start the calibration by clicking the button “Calibrate” in the Main User Interface.



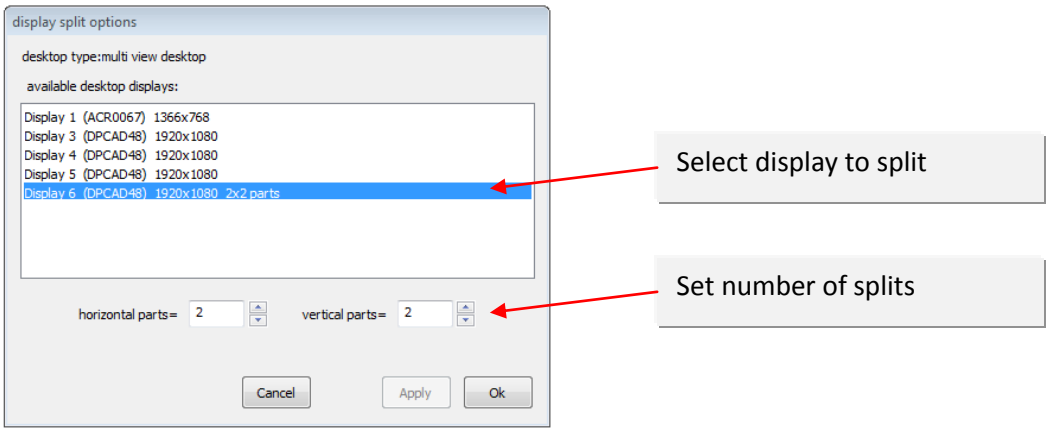
4.1 Preliminary settings

4.1.1 Basic Parameters



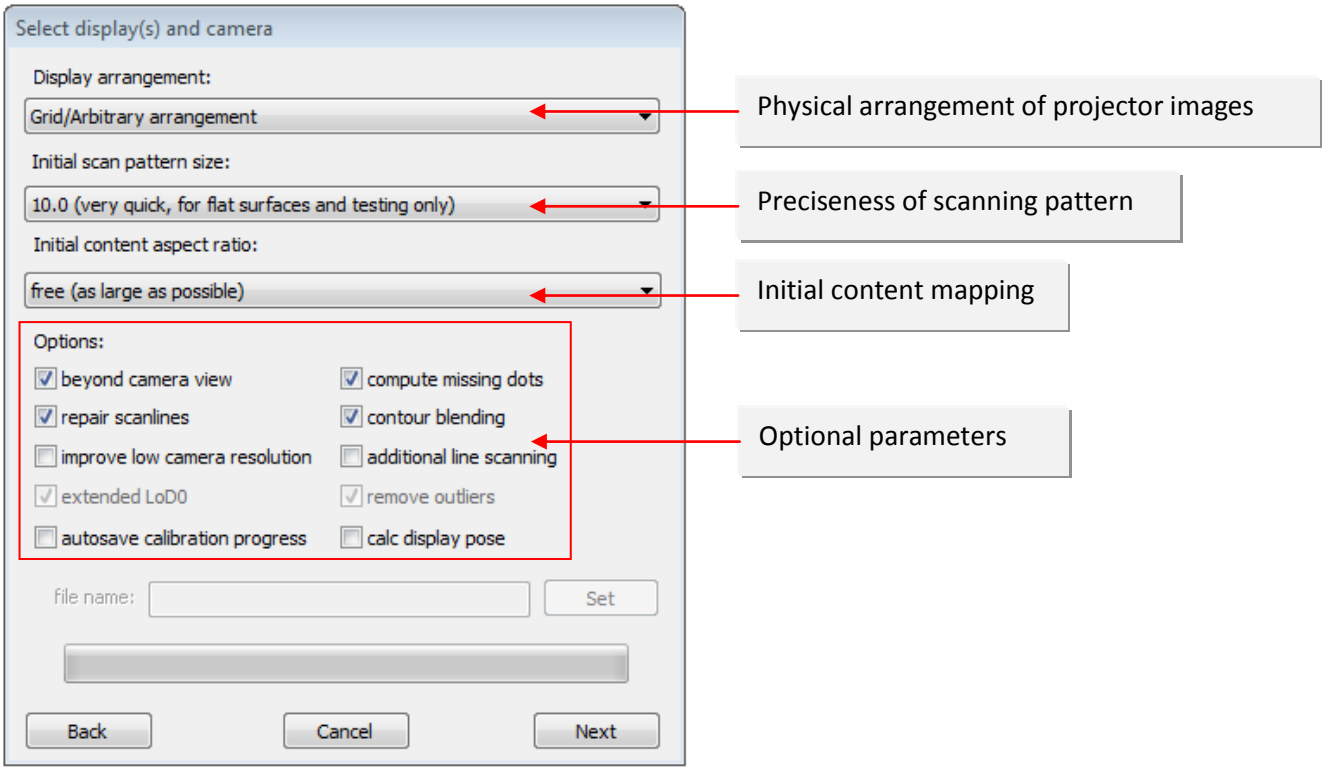
Choose the projectors you want to combine to a entire display by selecting them from the display list.

If you need to split display, select the “display split” option (see 3.2):



Select the calibration method depending on the geometry of your screen (see 3.1).

4.1.2 Advanced Parameters



- Display arrangement: Select appropriate arrangement (see 3.3). If in doubt, select “Grid/Arbitrary arrangement”.
- Initial scan pattern size: Determines the initial size of the final testing pattern and therefore the speed and accuracy of the procedure. Can be adjusted at a later step of the calibration procedure.
- Initial content aspect ratio: Determines how the initial mapping between camera position and projected result is handled. Can be adjusted at a later step of the calibration procedure.

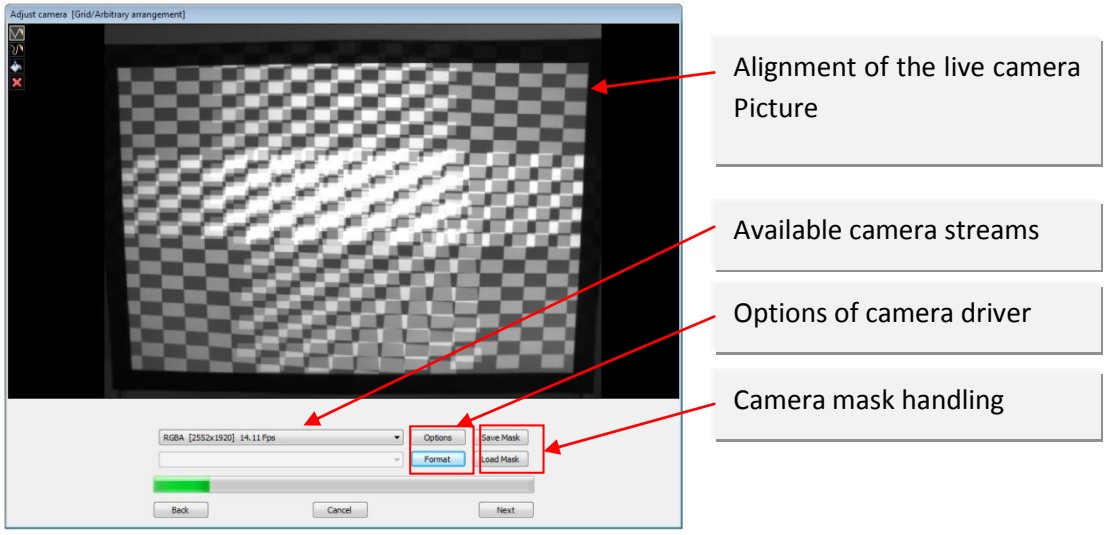
There are a couple of optional parameters. They are there to cope with difficult projection scenarios. If in doubt leave all parameters on their default value.

Name	description	recommendation
Beyond camera view	Projected areas outside the camera's image are computed, too. This option is useful if projecting on flat screens without having all the projection filmed by the camera.	activated
Compute missing dots	Adds an error correction when filming the dot test pattern. Missing dots are reconstructed according to their surrounding dots, therefore only singular failures can be corrected.	activated
Repair scanlines	Adds error correction to line scan-based calibration methods	activated
Contour blending	Improves the overall result if there is a black frame around the screen	activated
Improve low camera res.	useful only if you have a comparable low camera resolution (PAL, VGA, etc.). It is not necessary to activate this option if you have ahigh resolution camera (FullHD and above).	not activated
Additional line scanning	Adds error correction performing an additional the line scan. Note: Apply this error correction only, if the projected images and the camera image are aligned on the same baseline. Increases the scanning time very noticeable.	not activated
Extended LoD0	Deprecated parameters	ignore
Remove outliers		
Autosave calibration progress	Creates a calibration backup file after each individual projector scan. Use if you have a large number of projectors and/or slow scanning speed	not activated
Calc display pose	Creates information to pass to third party applications for projector-specific perspective rendering	not activated

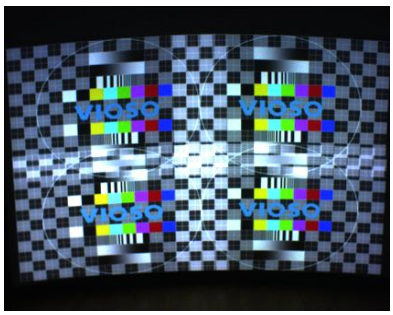
4.2 Camera setup and configuration

4.2.1 Camera Setup – basic settings

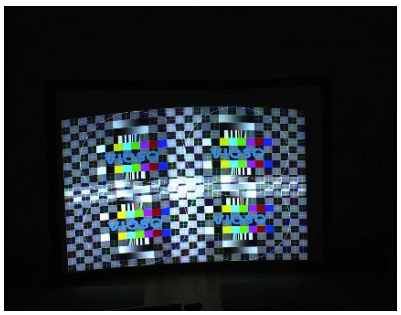
The camera setup dialog assists in placing and configuring the camera for the scanning procedure.



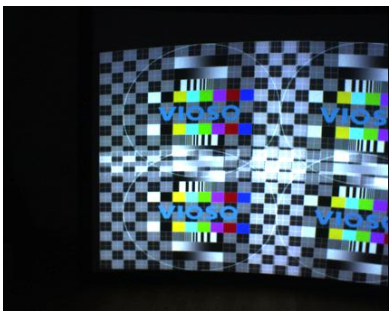
The camera is an essential component for whole calibration process. Configure the camera so that the entire surface being used is visible and the entire projection is captured by the camera:



OK



Bad: too far away



Bad: image is incomplete

The more realistic the camera image, the better the calibration results. In many cases, automatic calibration fails as the result of incorrect camera settings. To adjust the camera settings, use “Adjust” and “Format”.

Deactivate the camera’s auto-focus feature and focus the camera manually. Deactivating other automatic camera settings such as white balance or brightness adjustment is also essential. Experiment with different brightness levels on your camera in order to achieve optimum correction results.

common camera settings and how to adjust:

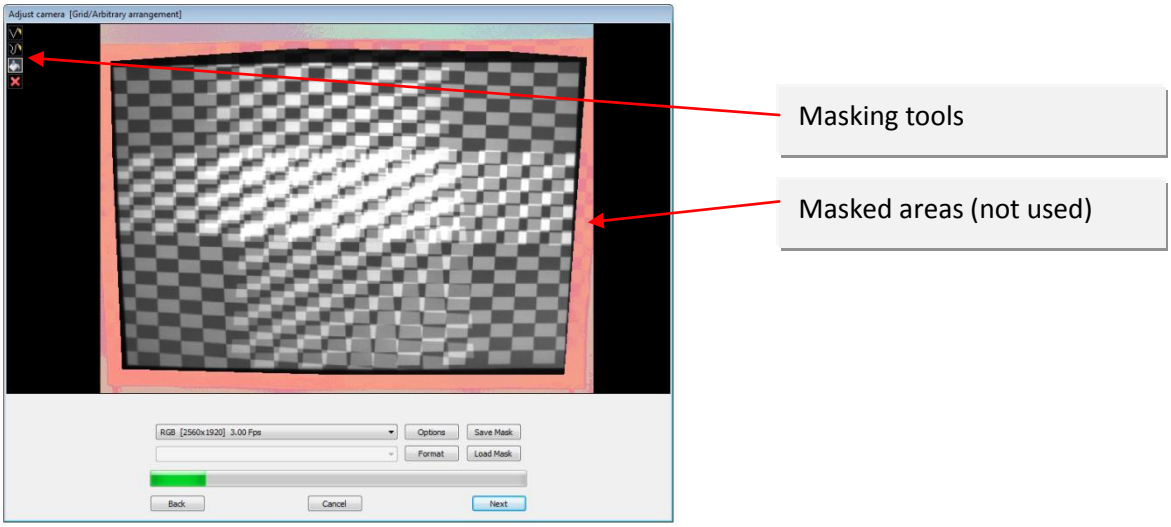
Automatic focus= off
Automatic white balance (AWB) = off
Exposure = manual
Shutter speed = set to the lowest value (e.g. 1/50)

Hint - how to test whether "Autofocus" or "AWB" is deactivated:

Move your hand up and down right in front of the camera. If the camera does not automatically adjust the image, automatic settings are disabled, which is mandatory for camera-based wall correction.

4.2.2 Camera Setup – Masking

You should mask the live picture shown in the alignment window with the tools on the left side, so that the camera only recognizes the important areas.



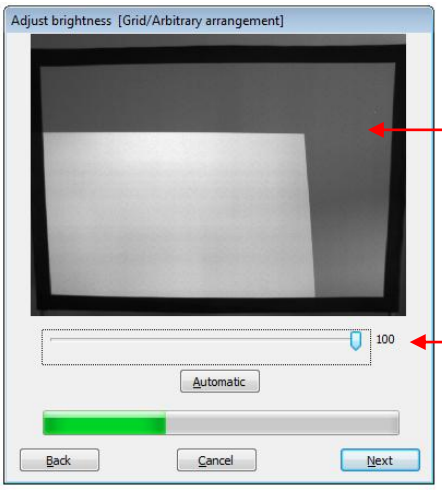
It is strongly recommended to save the mask somewhere locally on the disk. Use the "Save Mask" button to create a BMP-file that resembles the mask. It's possible to edit this mask using third-party imaging applications.

"Load Mask" loads masks definition from a BMP file and applies it instantly to the camera image.

4.3 Test pattern setup

4.3.1 Adjust brightness of test pattern

You can manually adjust the brightness of the testing pattern using the corresponding control. The color of the surface visible in the camera image must be optimized for color rendering that is as realistic as possible – not too dark or too bright.



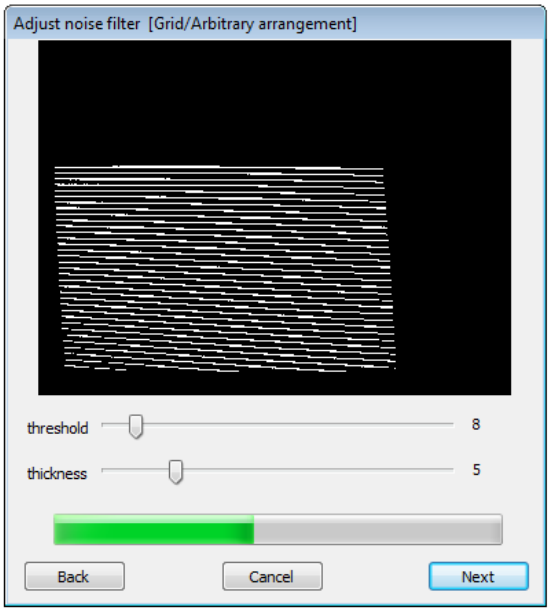
Live image for instant feedback

Avoid a bad camera image. Try to get a more realistic image of the surface.

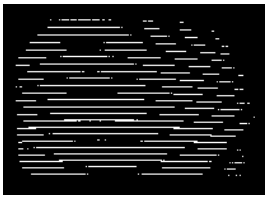
4.3.2 Noise reduction filter

In the next step, adjust the noise filter used for reading the test patterns. The objective is to obtain continuous lines with no visible camera interference (see illustration below). Experiment with the controls in order to achieve optimum results.

Good

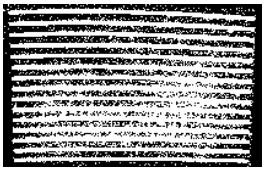


Bad



Lines are too thin and not continuously visible.

Lines are too thick and no longer visible at the top edge.



Noise is visible in the centre of the image. The level is set too high.

Note regarding the "***Line Weight***" control:

The line weight should primarily be selected so that the lines are continuous. However, thin lines are preferable since thick lines are related to the risk of excessive camera brightness.

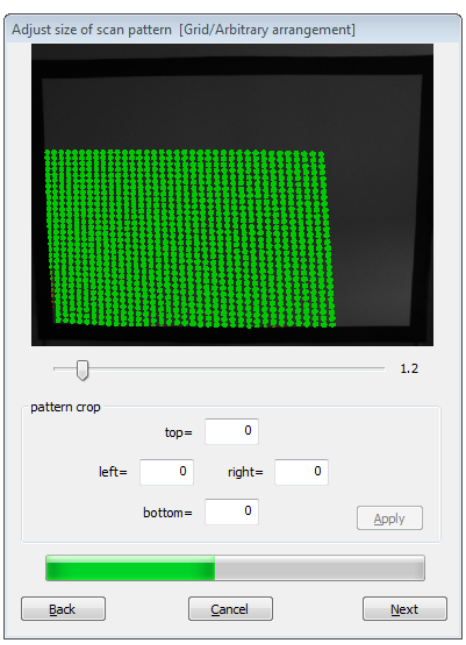
Note regarding the "***Level Control***":

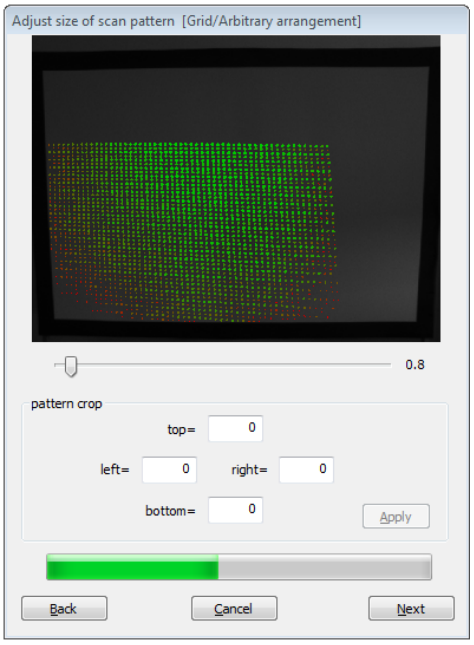
Set the level control so that all lines are easily visible at the edges and in the corners of the test image (striped pattern). However, be sure to avoid visible interference patterns!

Click "Next" to proceed with the calibration.

4.3.3 Resolution of test pattern

This is the most important visual feedback loop. The very result of the autoalignment depends on how this pattern is viewed and interpreted by the camera.





Good ***Bad***

Adjust the dot size to make sure all of them can be identified correctly. Avoid red dots whenever you can.

Pattern crop: This will leave out parts of the projection. This is useful if bad projection happens due to defocus, bad surfaces, etc. and influences from such bad projections must be avoided.

4.4 Automatic scanning procedure

4.4.1 Scanning and processing

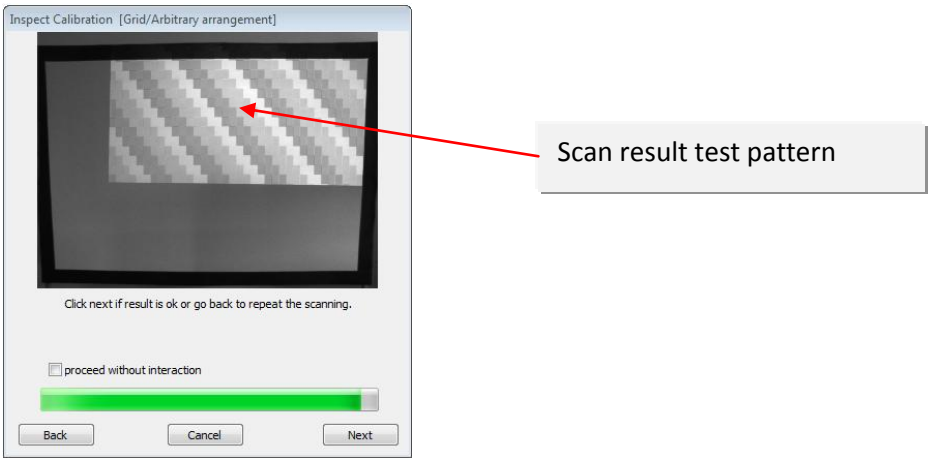
The calibration process is fully automated. The progress bar visualizes the current status of the calibration process. The process speed depends on the data transmission rate of the camera.

IMPORTANT NOTE:

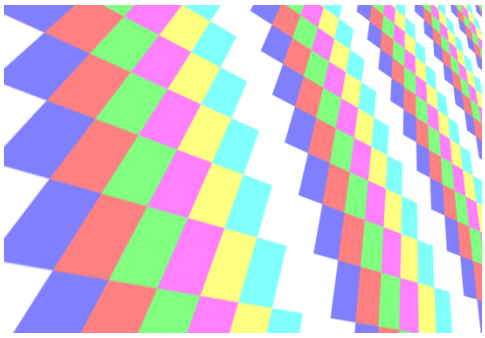
The projectors and camera must not be moved while calibration is in progress (indicated by the output of moving test patterns from the projector). In addition, the measurement process must not be interrupted by external influences (e.g. changes in ambient light, persons between the projector and projection surface).

4.4.2 Verify scanning result (first projector)

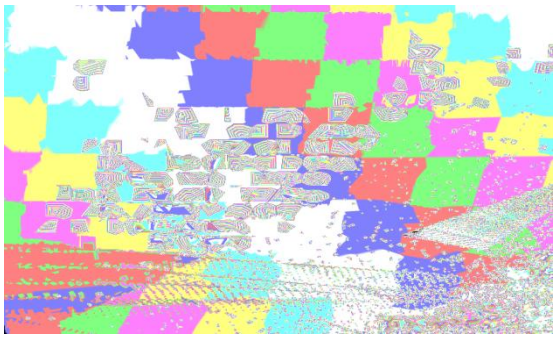
After the calibration of a projector the assistant will pause and show the result of the measurement. If there are errors in the displayed image simply go back to the adjustment of the parameters and optimize them for the next measurement.



Repeat the scanning with different parameters until the result is satisfying.



GOOD:
test image after scanning comes without visible distortions, holes, etc.
=> proceed



BAD:
test image shows distortions due to scanning failures
=> repeat scanning

4.4.3 Repeat for all remaining projectors

If the scanning result is satisfying, the scanning procedure is repeated for each subsequent projector.

Clicking "Next" repeats the steps 4.3 to **Fehler! Verweisquelle konnte nicht gefunden werden.**.

If "proceed hands off" is checked the parameters for the calibration will be set once for all projectors. The assistant will not pause after the calibration of each projector and perform all subsequent scans without the need of human interaction.

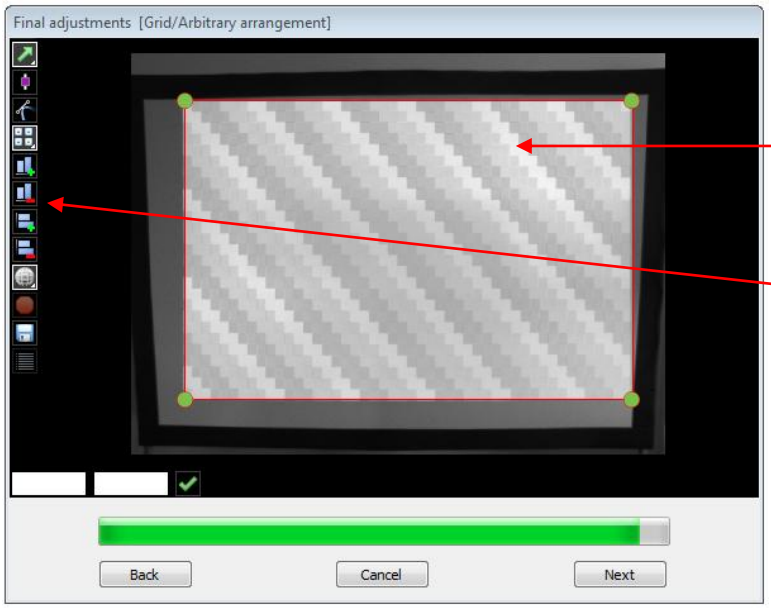
4.4.4 Calculate overlap and blending

The blending and image allocation is calculated automatically after projector scanning is completed.

The camera is not used for scanning anymore after this step. However, it is recommended to keep the camera in place for any required re-calibrations.

4.5 Initial content mapping

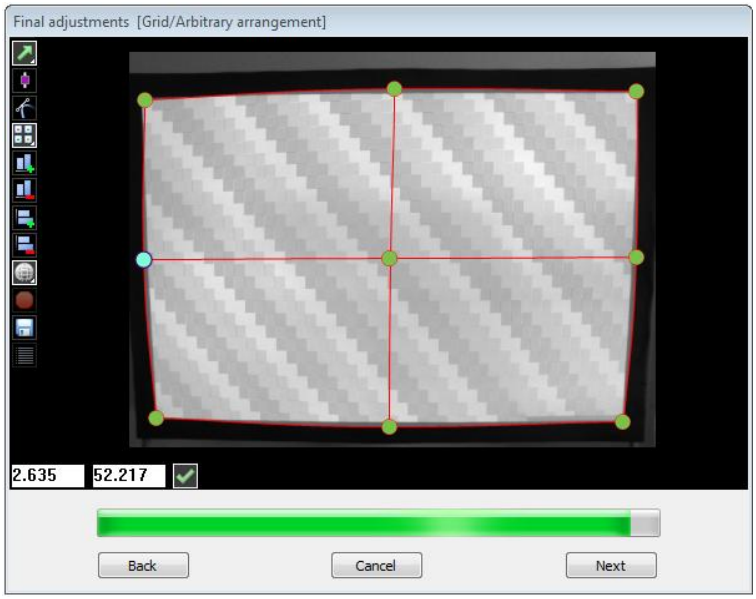
The result of the auto-alignment is a singular image containing all projectors. Depending on the initial screen aspect ratio value (see **Fehler! Verweisquelle konnte nicht gefunden werden.**) the projection screen is fully or partly filled with a seamless testing pattern.



Live-preview and interactive warping tool

Tools for editing screen warping (see 3.4)

The content mapping and warping is also used to correct optical influences caused by the camera, e.g. compensating pincushion distortion by using wide angle lenses.



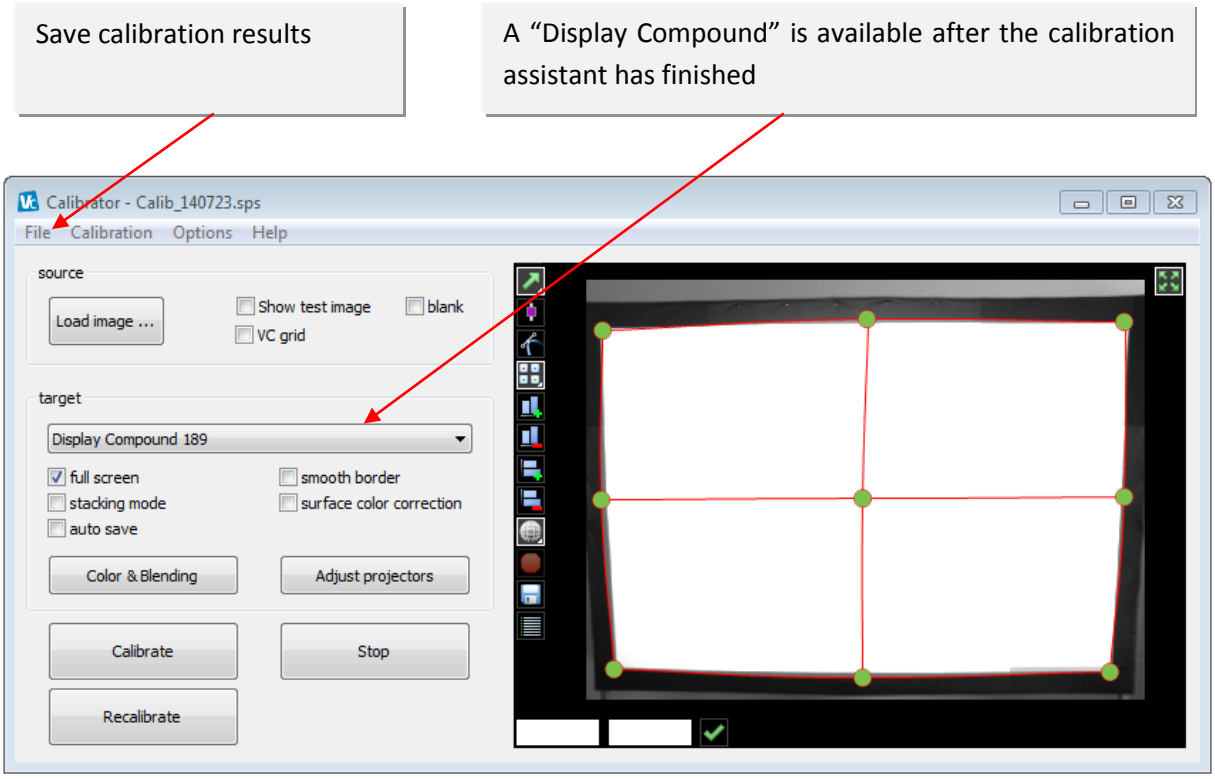
4.6 Finalizing

The projector alignment and blending procedure is now finished, and the dialog based setup assistant closes and the main user interface shows up.

The result needs to be saved, so select “File – Save Settings” to write a full Calibration Dataset (SPS) to disk.

IMPORTANT NOTE:

Saving takes a noticeable amount of time and requires a lot of disk space. Do not interrupt the saving procedure, even if it takes minutes (depending on the resolution of projectors and camera) and make sure that there is sufficient space on the disk or drive.



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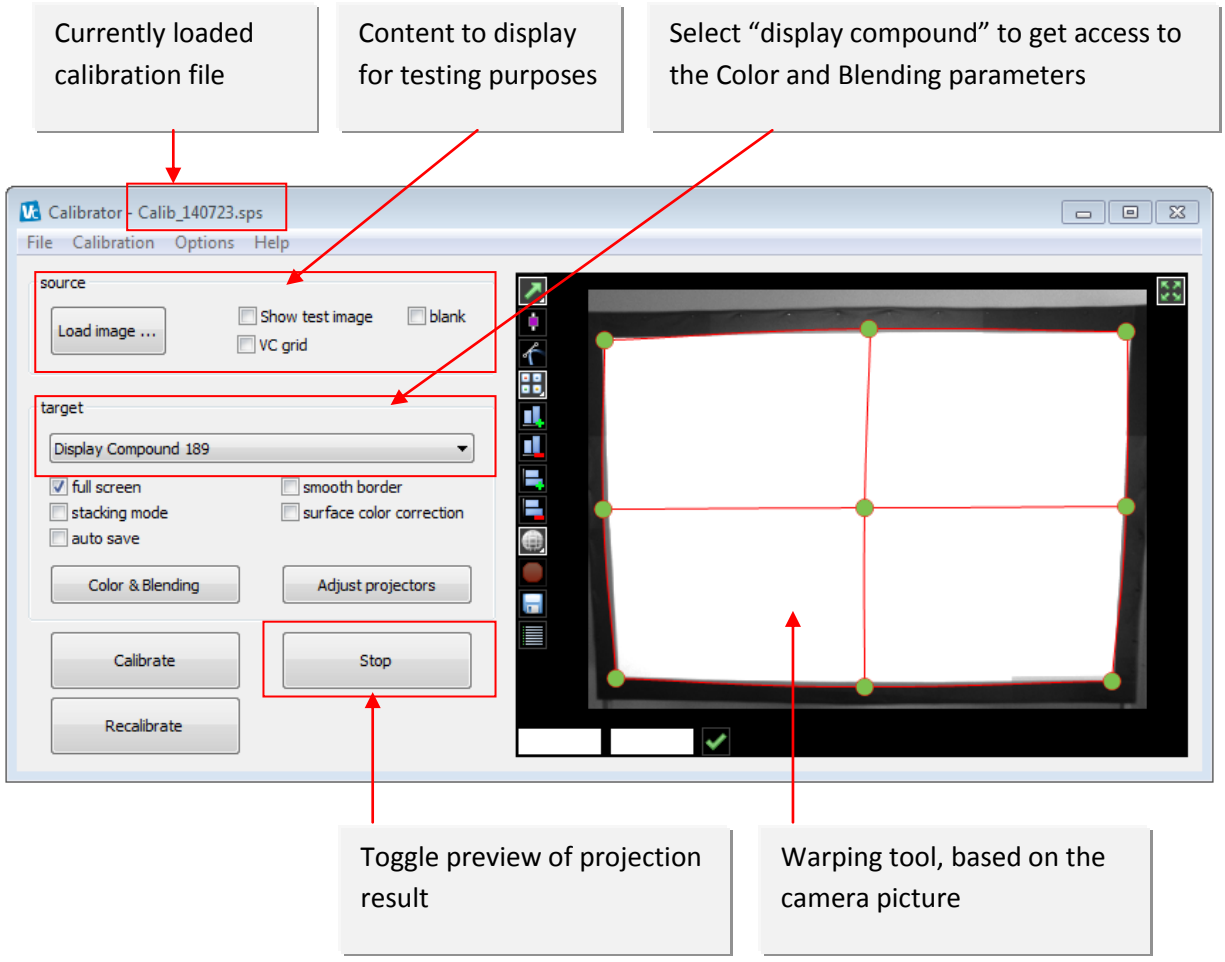
5. Edge Blending and Projector color matching

Any calibration can be edited basically in two ways:

a) Blending and Color of all projectors (“display compound”)
b) Individual Color balance of singular projectors
c) Warping (content mapping – see chapter)

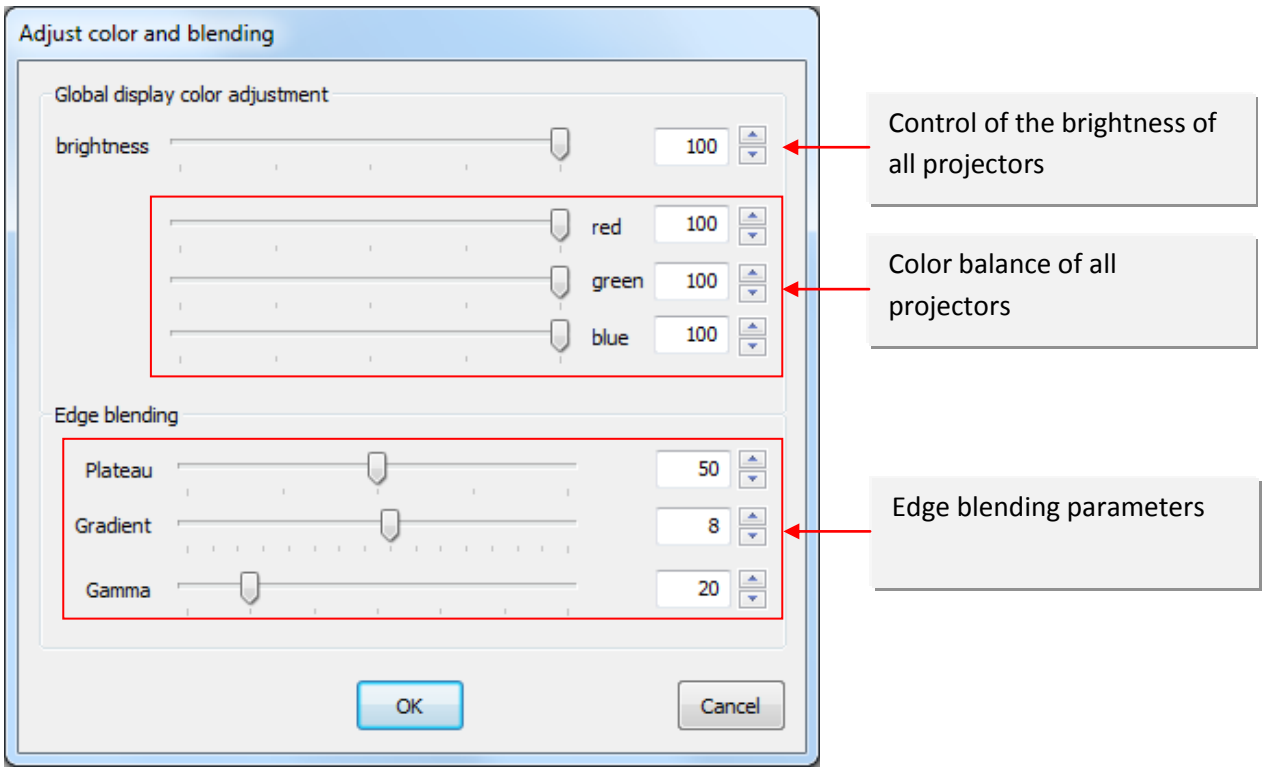
To edit a calibration, either continue immediately after a calibration procedure is finished or load an existing calibration from disk.

This is the look of the user interface when having a calibration active or loaded:



5.1 Editing and existing Calibration Adjust Blending and Color (all projectors)

The color balance as well as the blending parameters can be edited after a multi projector calibration has been finished and the “display compound” is selected as “target”.

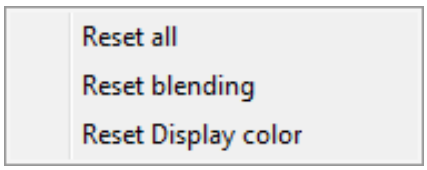


The color balance and overall brightness parameters affect all projectors that are connected by a display compound.

The edge blending parameters also affect all blend edges of all projectors. Though the parameters of the blending are automatically optimized during the calibration procedure, you might want to adjust these parameters to create the best blending experience based on the current content:

- Plateau: Emphases or damps the intensity in the blending zone
- Gradient: the size of the blending gradient applied to each overlapping edge
- Gamma: The brightness of the overlapping area

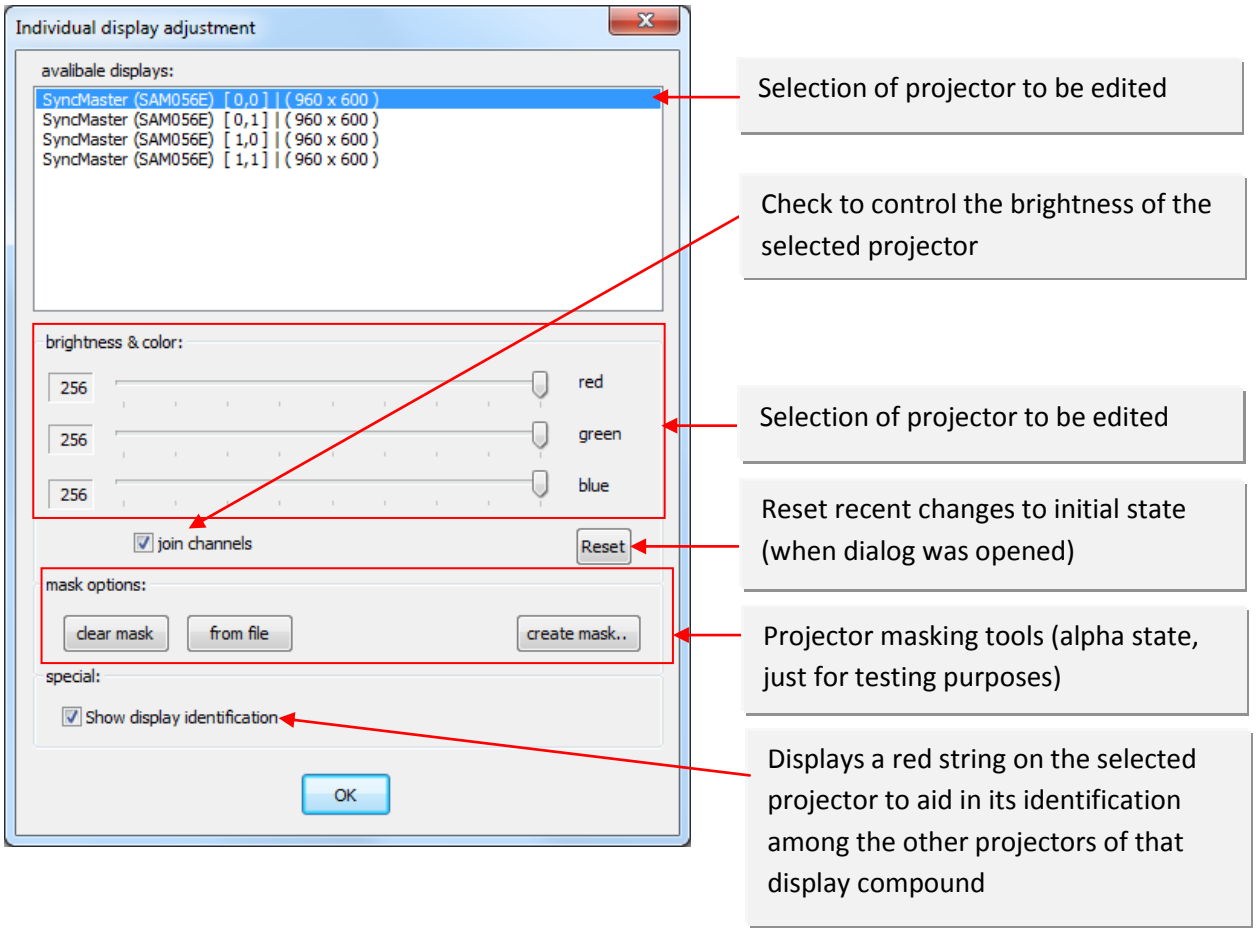
Right-click menu on the dialog:



Right-clicking the mouse on the opened dialog provides options to reset recently done actions to the state when the dialog was initially opened.

5.2 Individual Color balance of singular projectors

Each projector within a display compound can be edited in its brightness and color balance. This is useful to match the visual differences of projectors according to a seamless color representation.



Use the color sliders individually or check the box “join channels” to change the pprojectors intensity and color balance. Use this to increase the quality of the blending.

Projector masking tools:

This set of tools display and/or create a mask on the selected projector. This toolset currently is in alpha state and therefore meant for evaluation only.

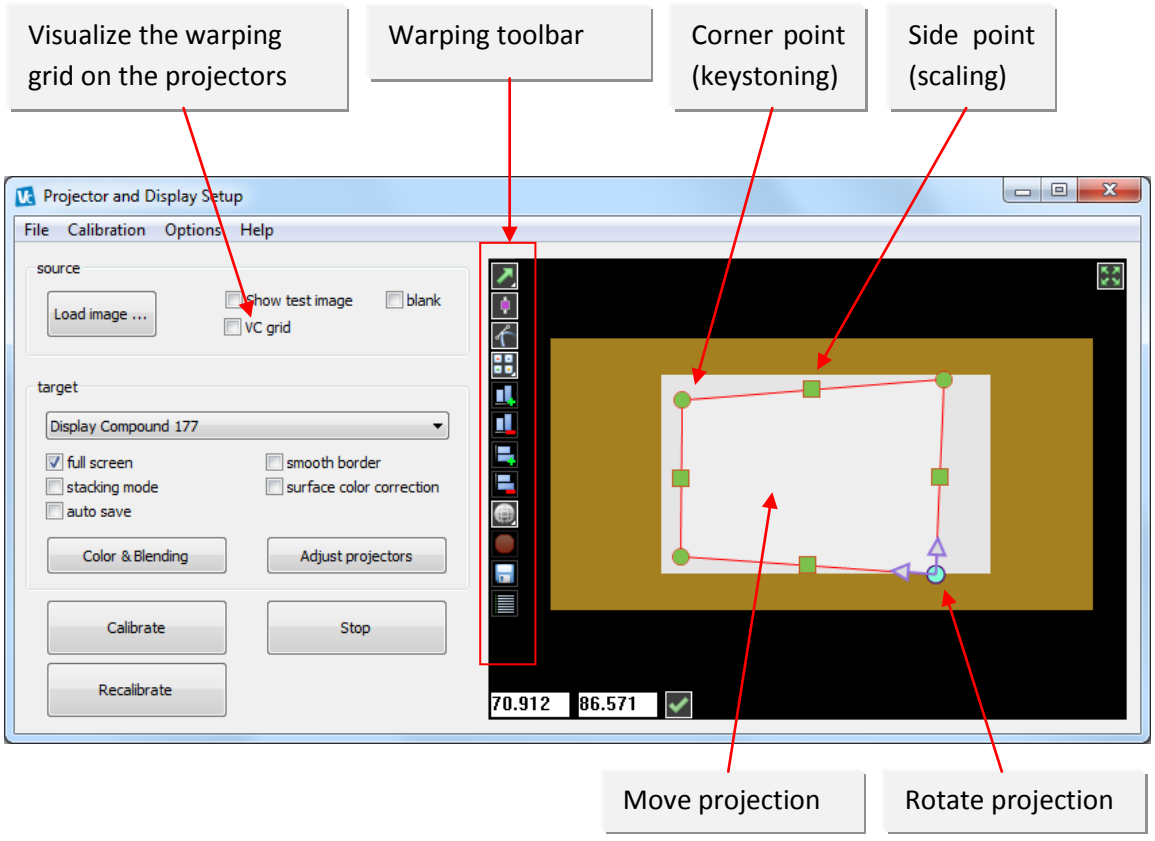
6. Warping and content mapping

This software provides numerous tools to map your content to the surface. This is called “warping” or “content mapping” – though it is always the same task.

Warping is referred as “VC”, which is an abbreviation for “virtual canvas”. A virtual canvas consists of one or more projectors, so applying a warp is basically independent from the number of projectors used in a soft edge blended setup.

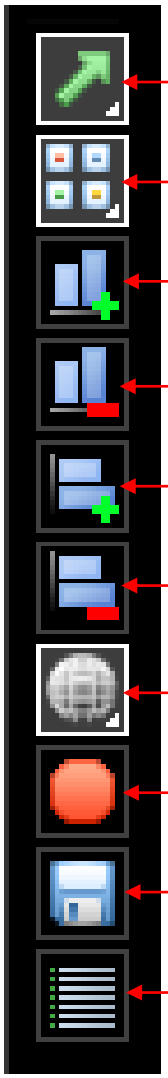
6.1 Warping tools

All warping tools are available from the main user interface:



6.1.1 Warping toolbar

The warping toolbar resides withing the warping area. It provides the most used warping features. Some buttons are toggle buttons, that display their state by visualizing different icons.



Toggle scaling / deformation mode

Toggles sensitivity of keyboard interaction (fine/coarse)

Increases the dimension of horizontal warping points (x-axis)

Decreases the dimension of horizontal warping points (x-axis)

Increases the dimension of vertical warping points (y-axis)

Decreases the dimension of vertical warping points (y-axis)

Toggles between curved and linear warping

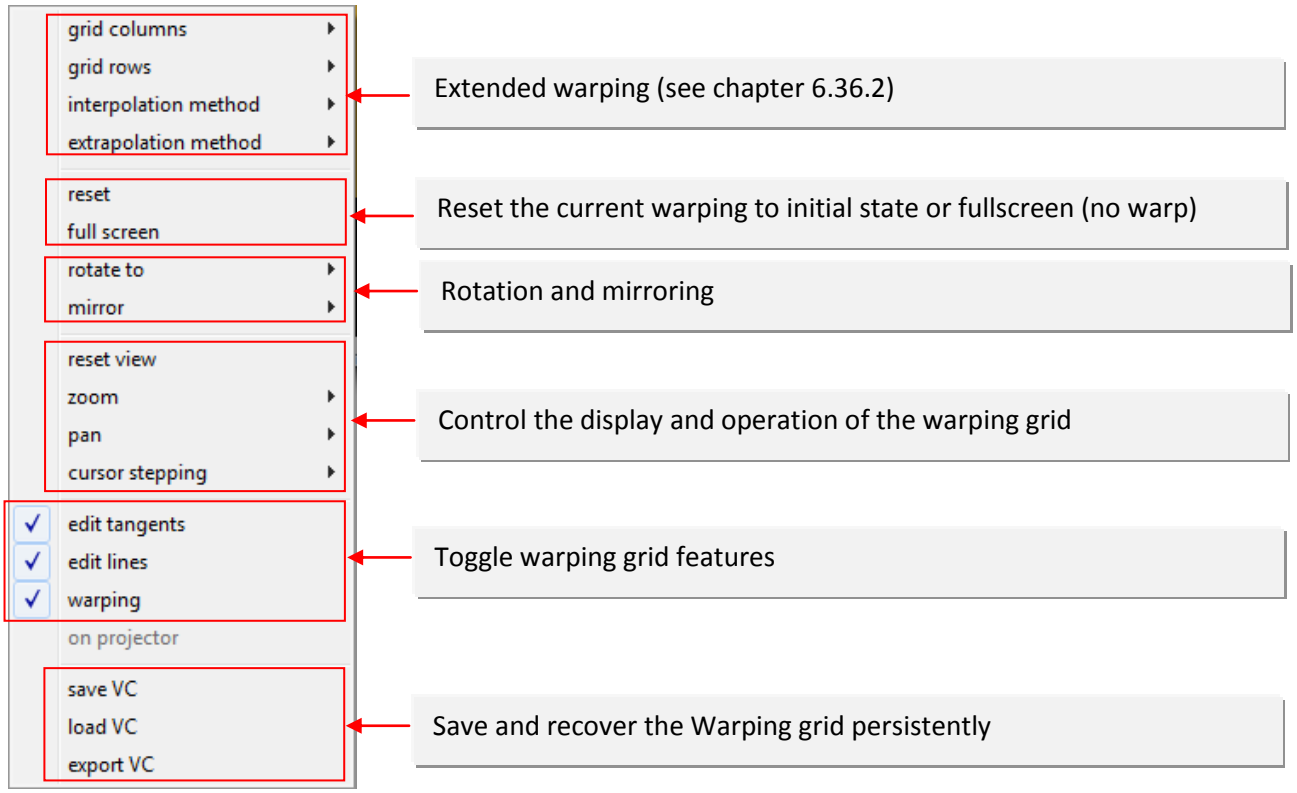
(only on single projectors): toggles On-Display Warping

Make in-memory snapshot of current warping grid

Recover warpings from previously made snapshots

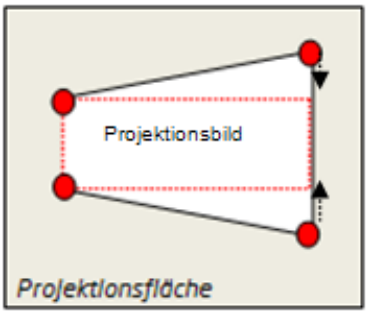
6.1.2 Warping Context Menu

The warping area also contains a context menu, that is available on right-clicking the mouse.

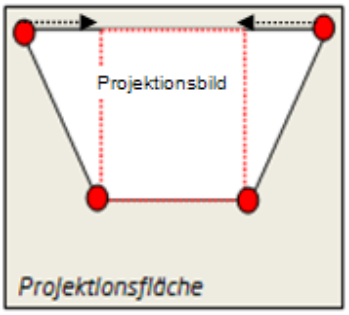


6.2 Basic Warping (4-Point)

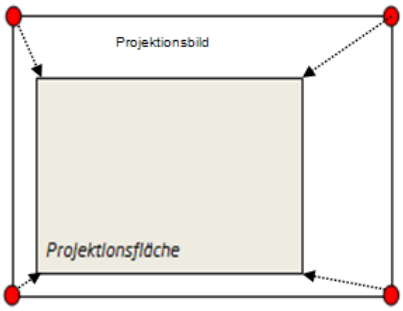
A typical warping and mapping task is to align a misaligned projected image to a flat surface. The very basic usage of the warping tool therefore consists of a 4-point warping, where each corner is handled accordingly:



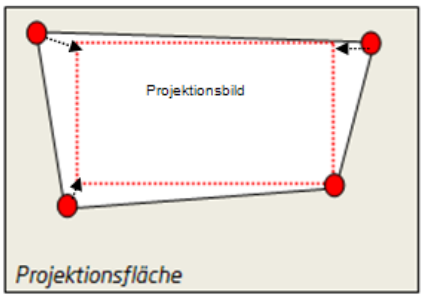
Case 1:
The sides of the projected image are of different length, e.g. projectors are angled laterally. Drag the red corners to the smallest size of the projected image.



Case 2:
The upper and lower sides of the projected image are of different length, e.g. projectors are tilted vertically. Drag the red corners with the mouse in order to straighten the sides.



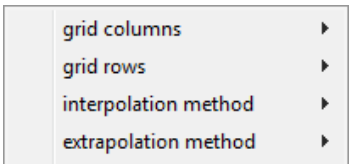
Case 3:
The projected image is larger than the projection surface, e.g. projectors are too far away from the projection surface. Drag the red corners to the size of the projection surface using the mouse.



Case 4:
All 4 sides of the projected image are of different length, e.g. projectors are tilted laterally and vertically. Drag the red corners as shown in the illustration.

6.3 Extended Warping

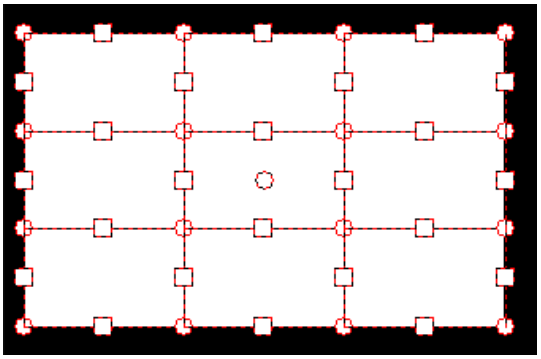
In addition to the basic warping functionality, the warping feature supports nearly unlimited complexity of screen shaping and content mapping. By increasing the number of control points, complex warping grids can be established.



Extended warping functionality, available via context menu

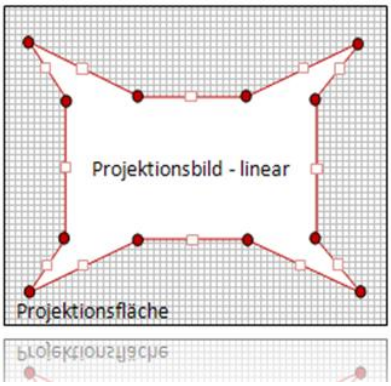
Right-click anywhere on the warping area. The context menu is displayed. It contains the entries “Grid Points X” and “Grid Points Y” in addition to two entries to select the interpolation and extrapolation method, all of which refer to the extended warping functionality. You can also change these settings in the “warping dialogue”. You will find it by selecting “Warp” and then clicking “Options”.

- *Grid columns and rows:*
  Use this function to insert warping points on the horizontal and vertical axis.

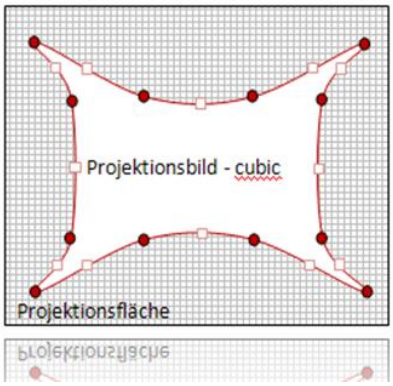


Warping grid with 4x4 points

- *Interpolation method:*
  Here you switch between linear and cubic support point interpolation. Linear interpolation is suitable for corners, edges etc. while cubic interpolation is suitable for rounded surfaces. Cubic interpolation is the default.



Linear support point interpolation: For corners, stairs etc.



Cubic support point interpolation: For cycloramas, columns etc.

- *Extrapolation method:*
  This is where you select the extrapolation method used for cubic warping. The changes affect the details. Making changes to these settings is generally not required.

7. VIOSO contacts

Should there be any questions which cannot be answered in the help section, please tell us about them. Please use the Support Function if there are any problems or errors. Wings Platinum can be updated via function Software Update. If you have any questions or suggestions, you can reach also us on the phone on weekdays from 8.00 am to 17.00 pm.

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VIOSO Anyblend Version: **3.0**