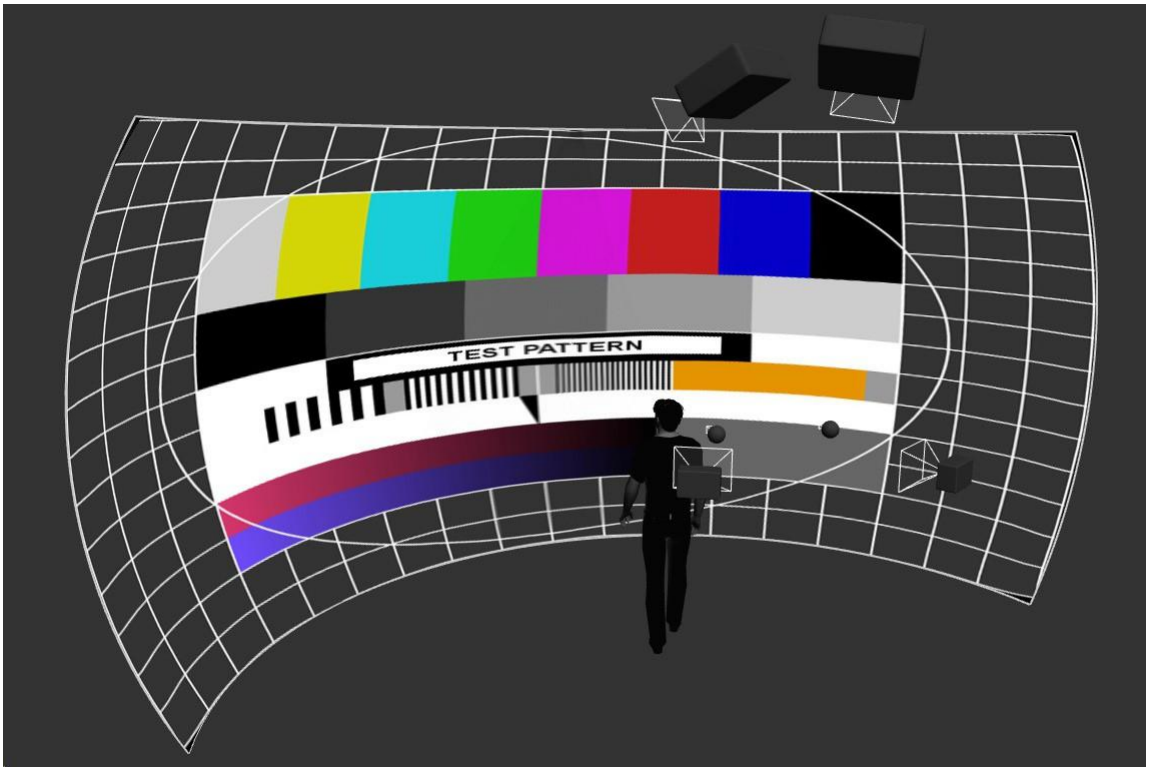
Immersive Display PRO v6.1

User Guide

1 Introduction

Immersive Display PRO are the ultimate geometric correction and soft-edge blending software packages for DirectX, OpenGL, Vulkan, Windows 7, 8, 8.1, , 10 and 11 Desktop. It is based on the proven image geometric correction and soft-edge blending technology for multi-projector projection on regular and irregular projection screens (cylindrical screens, full and partial domes and any other shaped projection surface).



Immersive Display PRO utilizes Immersive Display core components for image geometric correction and soft-edge blending configuration and presentation. With a simple user interface and using the system mouse and keyboard the projected output image can be mapped on any kind of projection screen. Overlaps and soft edge blending between projected images can be adjusted using the fine-grained controls and gamma functions. A color correction per projector can be applied to match the color profiles among different projectors. Immersive Display PRO supports camera calibration files. A camera can be used to automatically calculate the geometrical correction and soft-edge blending. Using a standard HD webcam, users can create perfect and seamless multi projector setups.

Immersive Display PRO supports up to 16 projectors per PC, which can be configured in different horizontal and vertical stacking.

Note:

- **Immersive Display PRO supports seamless integration of desktop warping and full-screen games warping.**
- **Immersive Display Desktop supports only desktop warping.**

Typical application of the software is flight simulators, car racing simulators, projector based home cinemas and other first-person software packets in combination with multiple projectors and some sort of omni-directional projection screen.

Immersive Display PRO is designed for home and professional environments. Applications include:

- Home Entertainment System
- Flight, Ship and Car simulators
- Business Data Visualization
- Interactive & Touch Displays
- Conference rooms
- Video Playback
- Live Digital Motion Graphics

2 System requirements

The following is the required minimal configuration:

- PC with 2.0 Ghz or higher processor (64 bit)
- Windows 7/8/10/11 (64bit)
- 2 Gb or more RAM
- A moderate graphics card (NVIDIA or AMD/ATI)
- For creating a wide multi projector display in Windows 7, 8, 10 and 11 desktops, the following products are required:
    - NVIDIA surround 2D support for NVIDIA graphical cards
    - ATI Eyefinity support for ATI graphical card
    - Or Matrox DialHead2GO or TrippleHead2GO external hardware box
    - Or Nvidia Quadro graphics card with mosaic mode
- A common HD webcam (Ex: Logitech Webcam PRO 9000, Logitech HD Pro Webcam C920, etc.)

- Administrator privileges are required to **install** Immersive Display PRO.
- Administrator privileges are **NOT** required to **run** Immersive Display PRO.

3 Install and uninstall

3.1 Install

Note: Immersive Display PRO makes intensive use of DirectX runtime. It is required that the latest version of "DirectX End-User Runtime" is installed on the computer before Immersive Display PRO can be used.
At the moment of writing of this document, the latest DirectX End-User Runtime can be downloaded from this location:

https://www.microsoft.com/en-gb/download/details.aspx?id=35&40ddd5bd-f9e7-49a6-3526-f86656931a02=True

Immersive Display PRO comes in a single installer package. DirectX End-User Runtime web installer is included in the installer package.

Before the installation begins the installer check the following preconditions:

- If Immersive Display PRO is still running
- If Immersive Display PRO is already installed

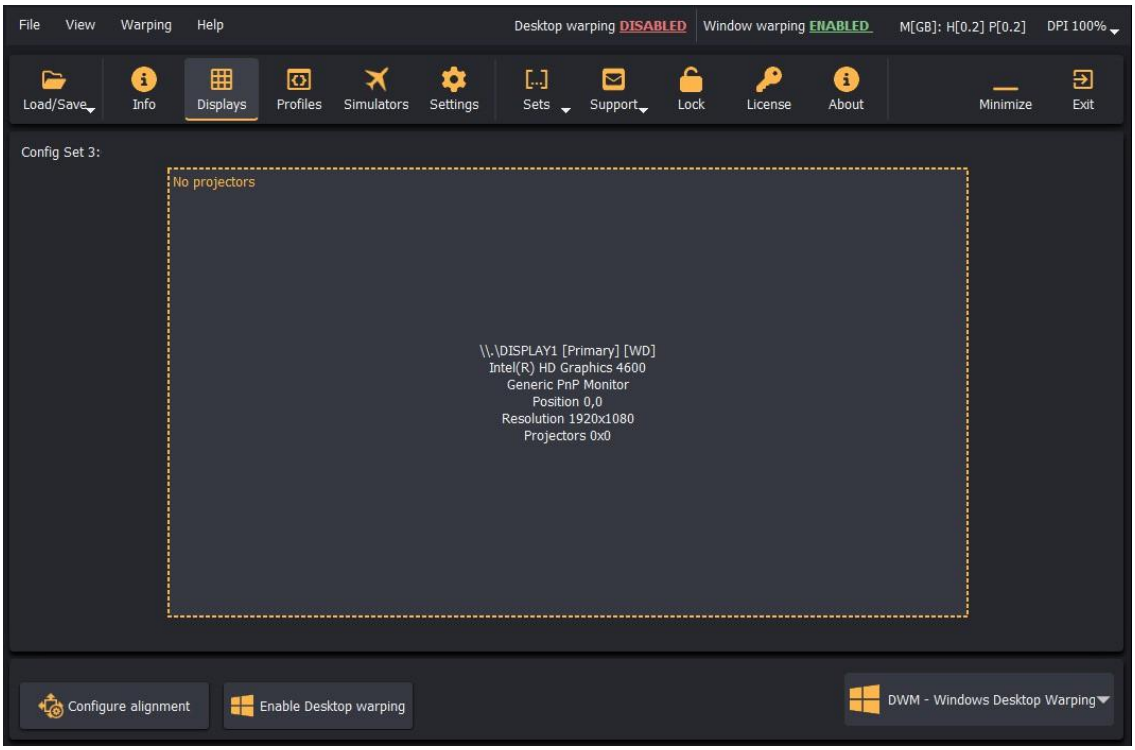
In both cases, the installer will stop and prompt the user to take the appropriate action before staring the setup again: If Immersive Display PRO is still running installer will prompt to quit Immersive Display PRO first. If Immersive Display PRO is already installed the installer will prompt to uninstall it first.
After the install a system restart is needed to complete the post installation steps.

3.2 Uninstall

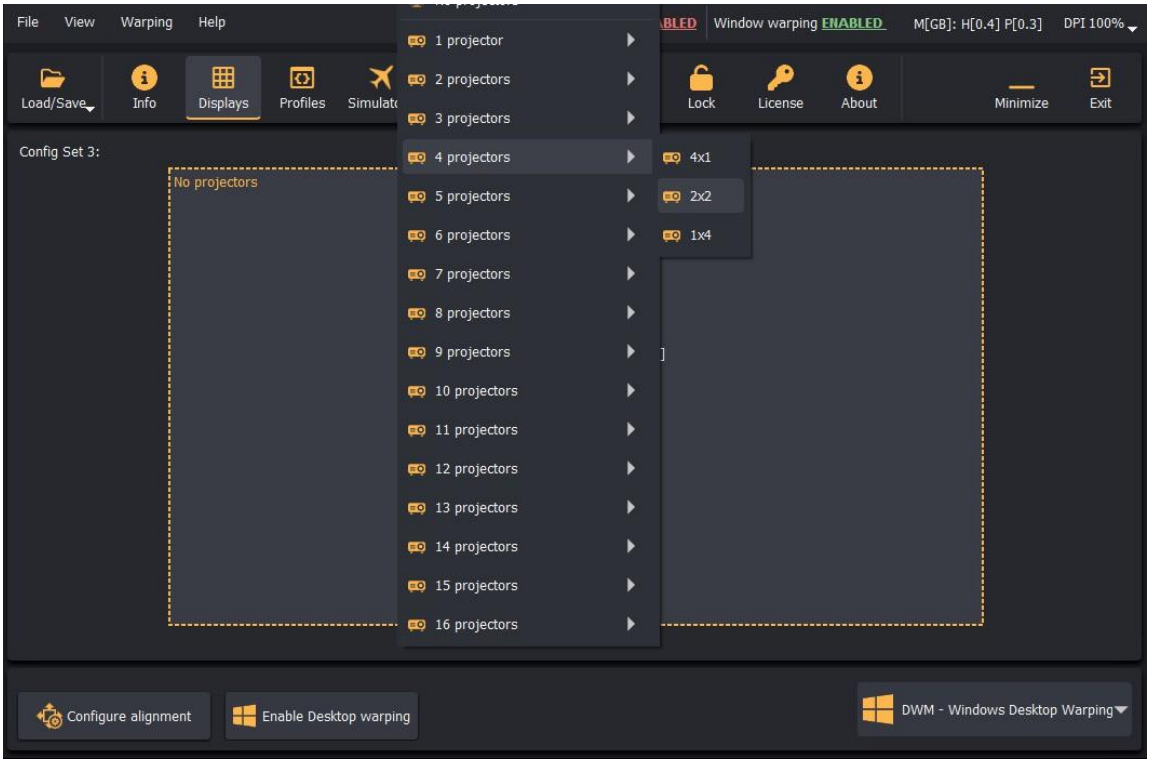
Immersive Display PRO can be un-installed using the uninstall short cut in the Immersive Display PRO menu or using the "Add/Remove Programs" from control panel.
After uninstall a system restart is needed to complete the post uninstall steps.

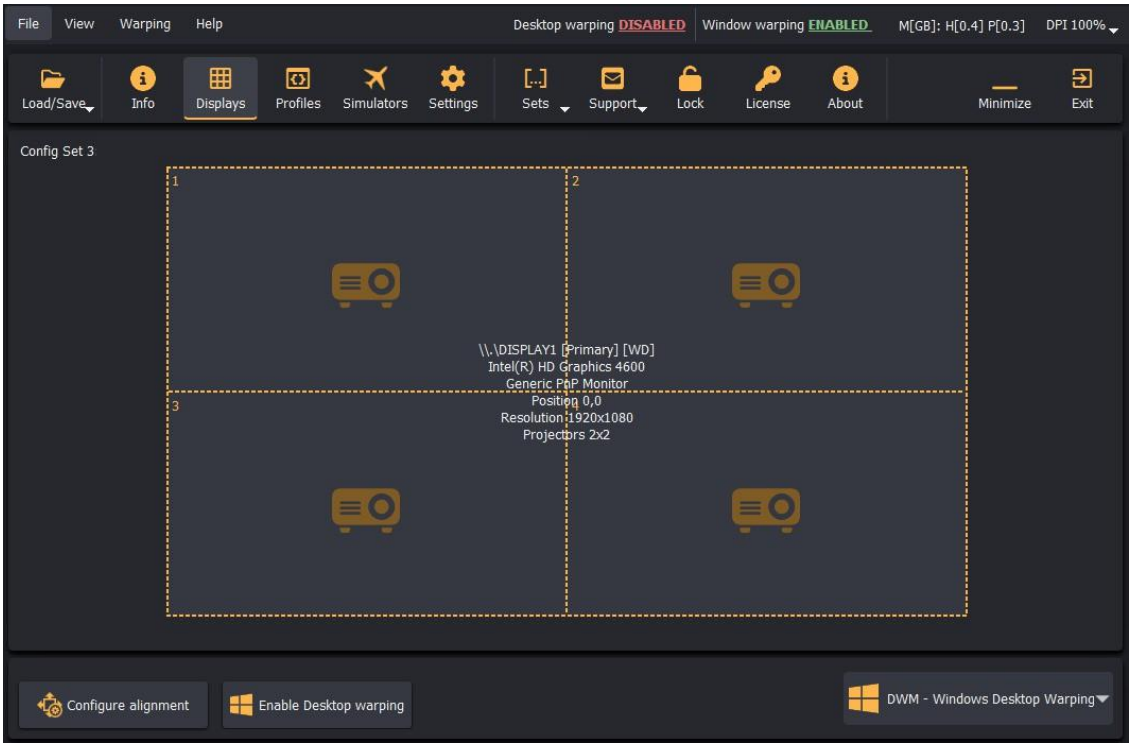
4 Quick Setup Guide

After installing, Immersive Display PRO can be started from the start menu. A simple and intuitive control and configuration dialog can be used to configure the needed geometrical correction and soft-edge blending.



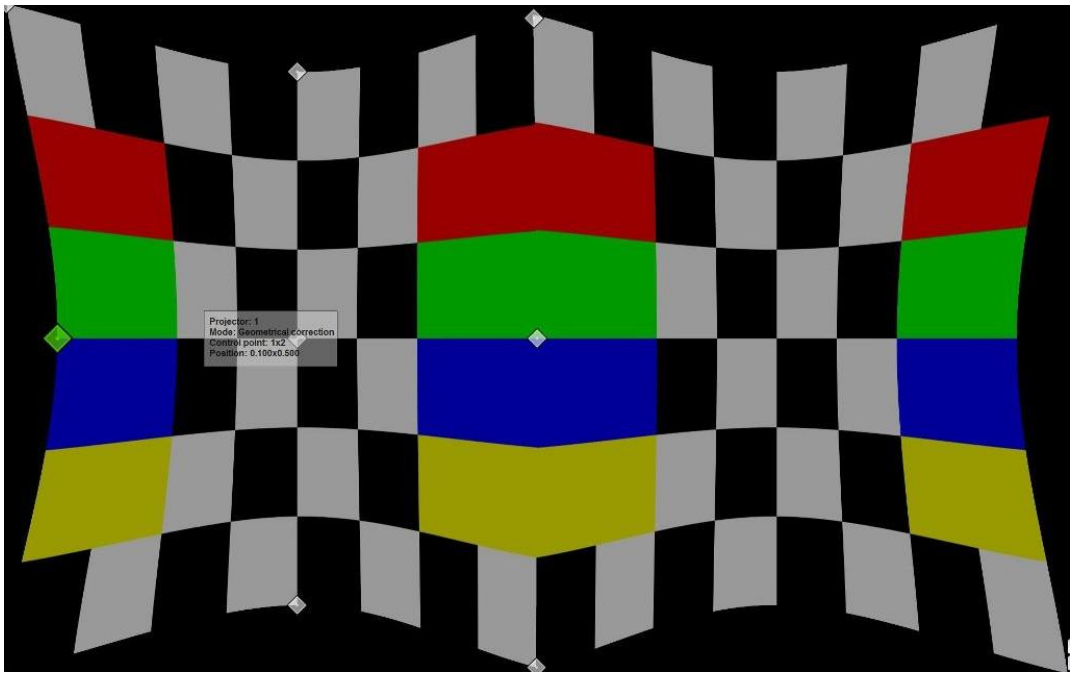
1 - Go to the displays tab and select the desired projector configuration per detected display.



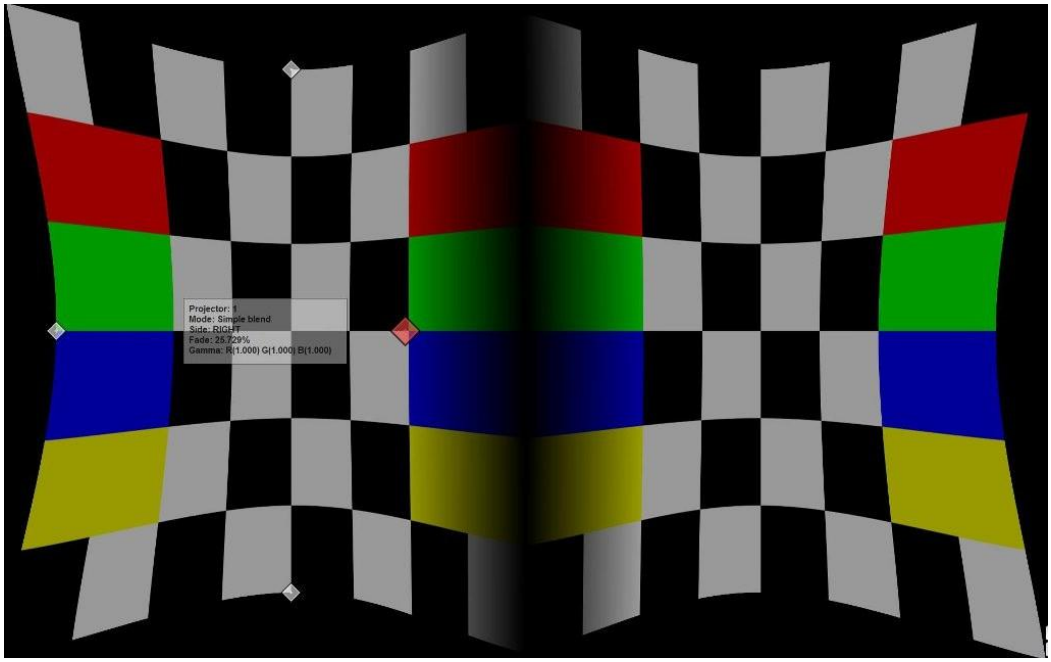


2 - Press the configure button to edit the geometrical correction and soft-edge blending. A configuration screen will be opened where the user can user the control points to map the projected output on the projection screen, define

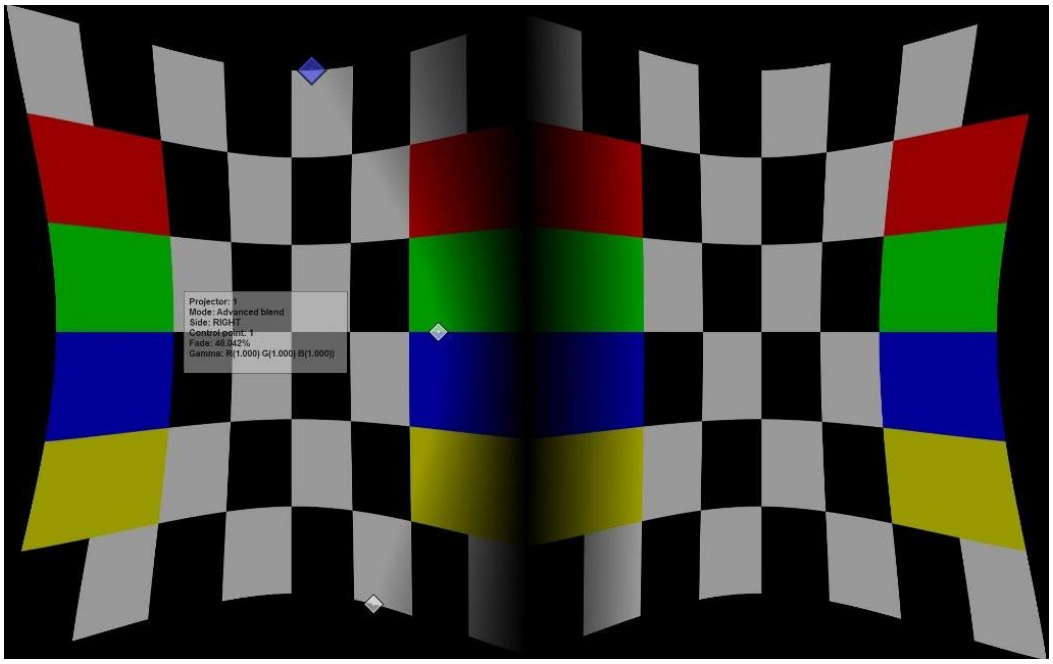
the overlap and configure the soft edge blending depending on the configuration mode.
In the geometrical correction mode, user can use the mouse of keyboard to move the green control points on the screen until the projected image is mapped on the projection screen.



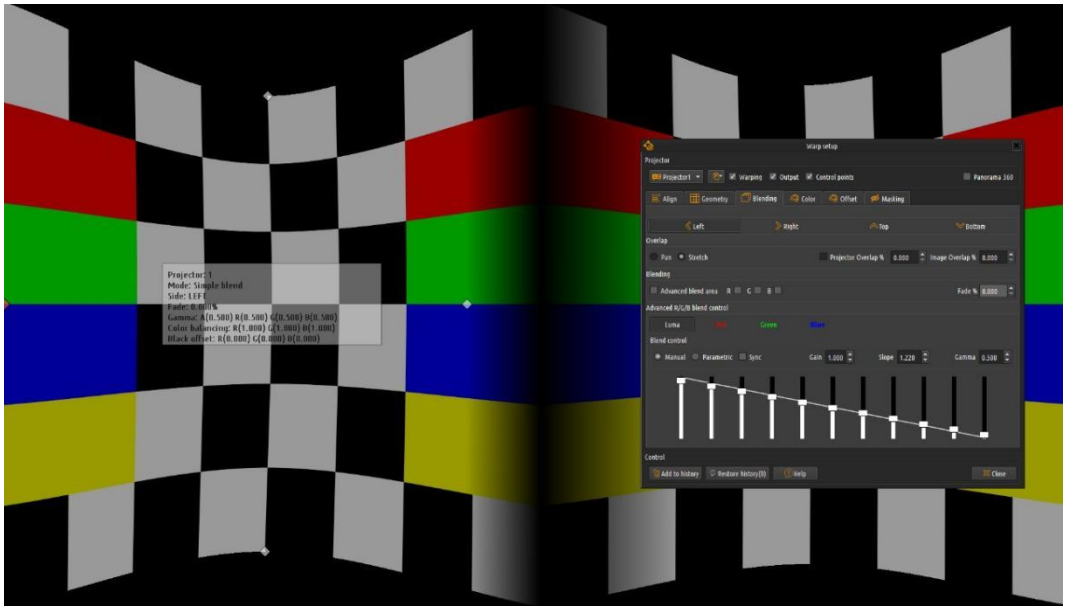
3 - After the image is mapped to the screen the overlapped regions can be defined and the soft-edge blending can be configured. Using the "F10" keyboard key, user can switch between geometrical correction and soft-edge blending mode.
The default soft-edge blending mode is the "simple" mode where the edge-blending region follows the contour of the edge of the screen. In most cased this mode is enough to configure the soft-edge blending.
In the "simple" edge blending mode user can drag the red control points for every edge to adjust the soft-edge blending region. Using the mouse scroll button the gamma values for all tree components(R/G/B) can be adjusted per region).



4 - For more complex setup with irregular projection screens user can switch to advanced blending mode using the **advanced configuration dialog**. In the "advanced" blending mode user can define more control points per edge and move the blue control points independently to match the contour of the projection screen and the overlap region. Using the "F12" user can switch between the blending regions. Using the mouse scroll button the gamma values for all tree components(R/G/B) can be adjusted per region).

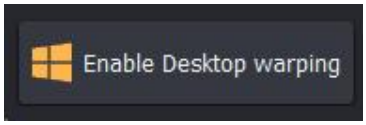


5 - Finally, by pressing the "D" key, the advanced configuration dialog can be show or hidden. From the advanced configuration dialog user can fine-tune the gamma values independently for all tree components(R/G/B).



6 - After the configuration is finished, user can press the "Esc" key to exit the configuration screen. The configuration can be saved using the "Save/Save As" button on the control and configuration dialog. This configuration will be used the next time when Immersive Display PRO is started again.

7 – When running on Windows 7, Windows 8, Windows 8.1 or Windows 10 System, user can check the "Warp desktop" check box in the control panel. This will enable warping of the complete desktop, including all applications running in windowed and full-screen mode.

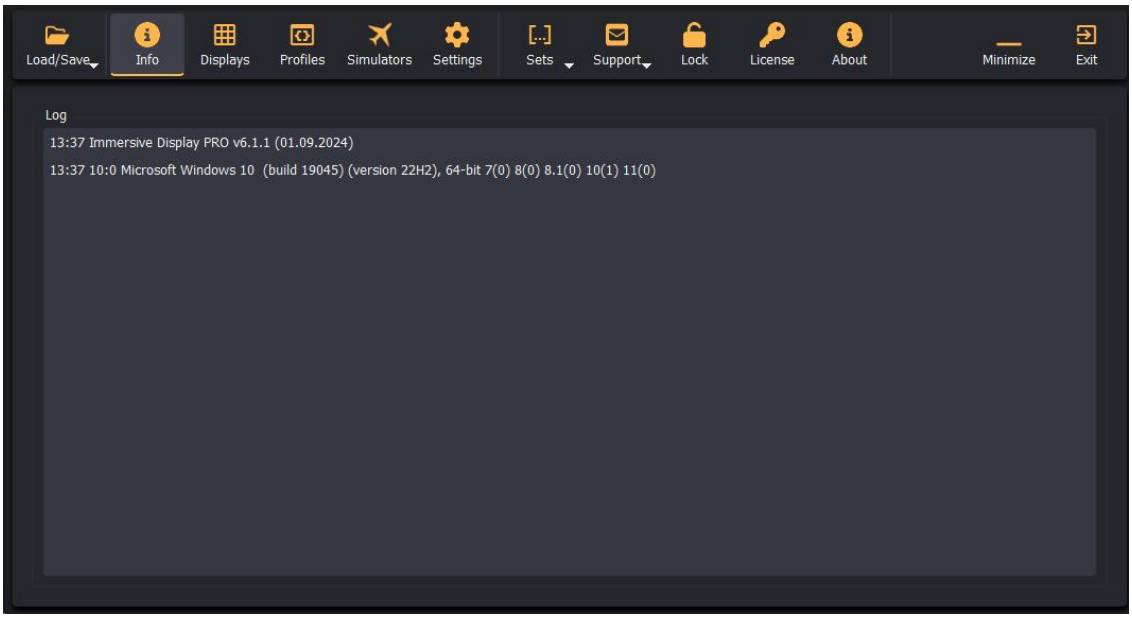


8 - Pressing the "Hide" button, Immersive Display PRO will be minimized on the system tray.

5 Control dialog

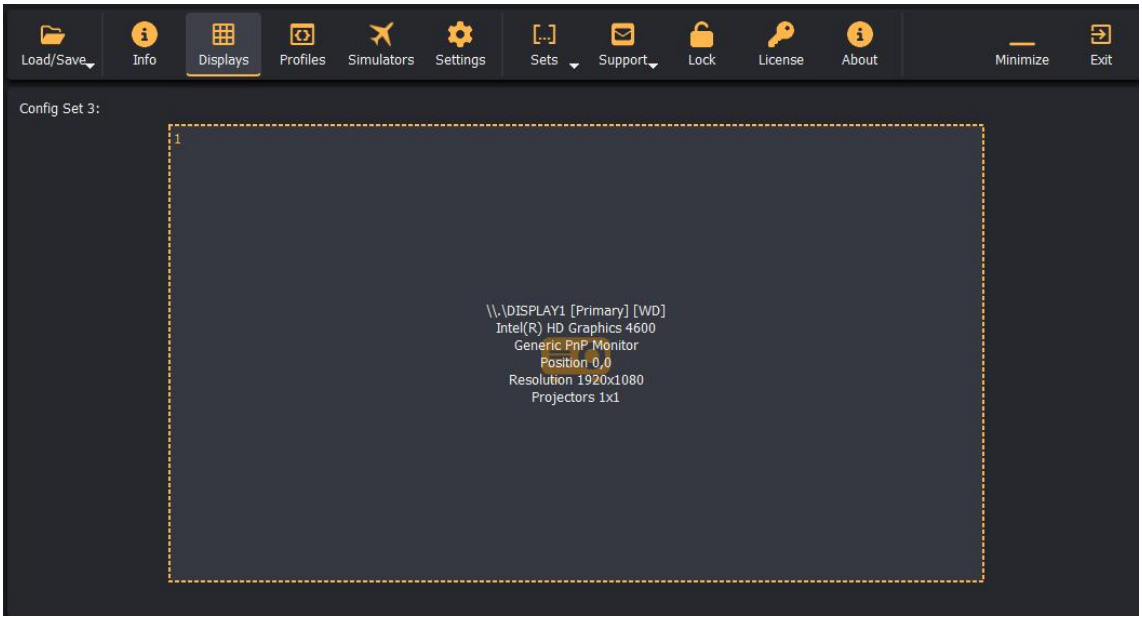
The control dialog has four tabs and a button bar.

5.1 Info tab



The info tab contains the log window. Every time an application is started or the warping changes an info line will be added to the Log window.

5.2 Displays tab



The displays tab shows the detected displays on the system. Every time Immersive Display PRO is started, it detects all displays present on the system. Every display is presented with a button containing information about the display system name (known to Windows OS), the resolution and the number of projectors connected to this display. Initially there are no projectors configured to the displays.

By clicking on the display button a popup menu will be presented with all supported projector configurations.

The following projector configurations (horizontal x vertical) can be selected from the drop-down menu:

- None (No projectors connected)
- External calibration (Load .procalib files from Immersive Calibration PRO)
- All possible (horizontal x vertical) projector configuration with up to 16 projectors

In special cases where graphical drivers have no support for display grouping, user can create a display group in Immersive Display PRO. This can be useful

when a client application can be maximized over multiple graphical card displays.
Note that grouped displays in this way cannot be used for desktop warping. The desktop warping feature requires one large spanned and grouped desktop. This can be achieved with NVidia 2D surround mode, NVidia mosaic mode, ATI grouped mode or external Matrox Dual or Triple Head2Go.

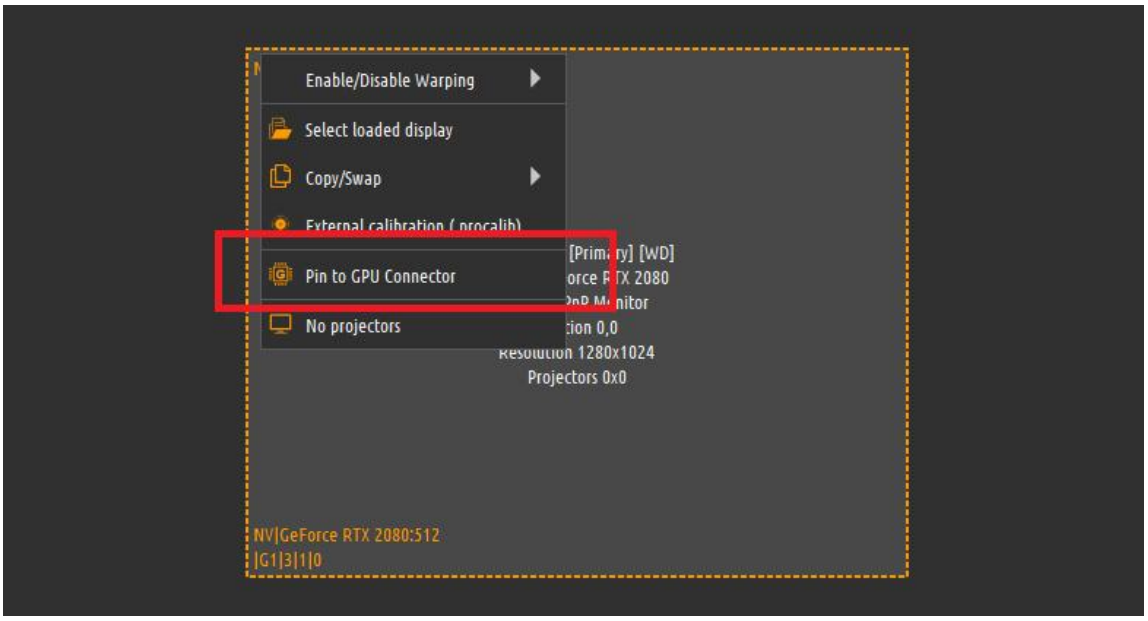
Displays changes

When multiple windows displays are used (or multiple graphical cards) Windows sometimes enumerates and names the displays in an arbitrary order. Because Immersive Display PRO stores the warping and blending configuration per display, when Windows enumerates displays differently, the previously configured display can be renamed differently or can swap position with another display.
When the option "Check for display change" is selected, Immersive Display PRO will detect any changes in the displays configuration since the last time the settings have been saved. If changes are detected, the displays tab will be cored red. Pressing the Left or Right mouse button on the display will open the context menu. The first item in the context many will open the previously saved displays configuration and the users can select (take over) the previously saved configuration.

Lock to GPU outputs

If a NVidia or ATI GPU is present on the system, the software will use the corresponding low level driver libraries to identify the exact GPU output connector that is used for this display. The connector info will be shown on the lower left part of the display.

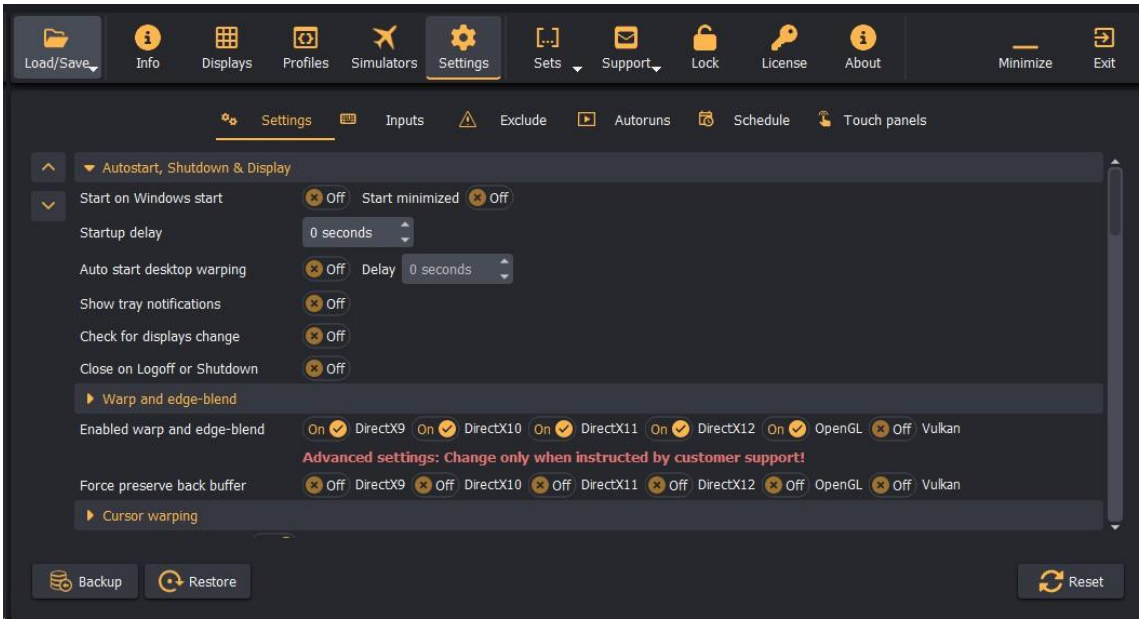
If you want to lock the settings for this display to this output connector, click on the display and select the option "Pin to GPU connector"



The lower left part of the display will now indicate that the settings are locked to this connector. After that, the software will apply the settings to any display connected to the same connector.

This will improve the software configuration whenever windows display configuration changes. This includes changes in the enumeration order, position and resolution of the displays, etc…

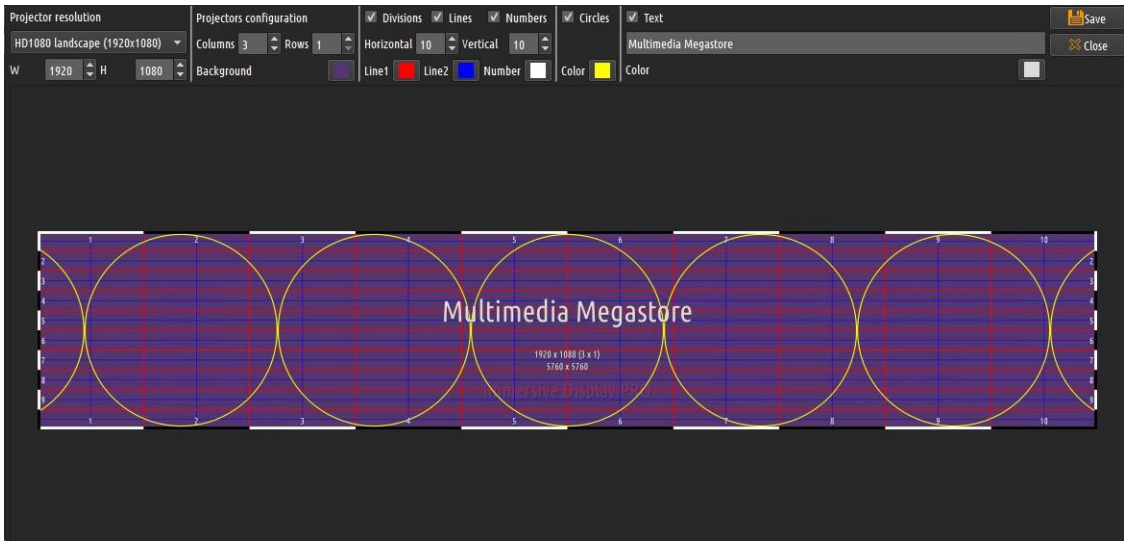
5.3 Settings tab



The settings tab allows the user to configure Immersive Display PRO. Under the "Settings" tab the following options are available:

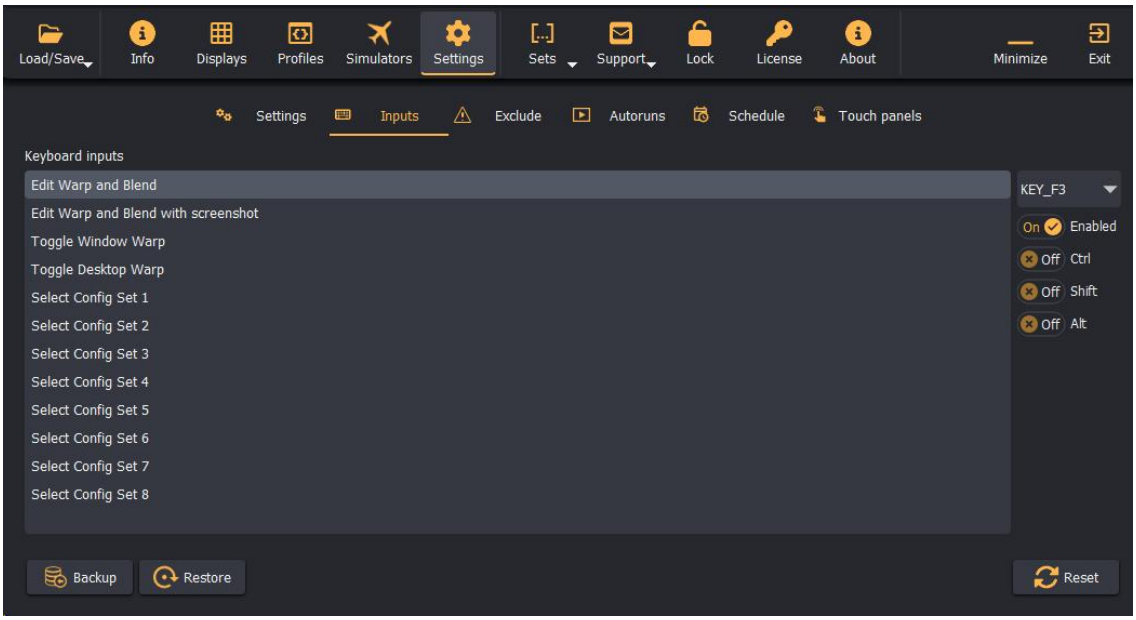
- Start this application when Windows starts: If checked immersive Display PRO will be started automatically when windows is started.
- Auto start desktop warping: If checked immersive Display PRO automatically starts the desktop warping on startup.
- Start minimized: If checked Immersive Display PRO will be started silently and will be minimized in the tray.
- Show tray notifications: If checked, windows will show notification in the tray whenever desktop or window warping state changes.
- Warp cursor: If checked the system cursor will be shown properly in the geometrically corrected image
- Advanced warp cursor: If checked the software will use a new cursor warping technology that is more robust and should work seamlessly with all programs.
- Bi-cubic sampling (Desktop): Uses advanced bi-cubic sampling to improve the image quality for desktop warping.
- Filter: Select one of the Linear or 4 available anisotropic filtering to be applied when Bi-cubic sampling (Desktop) is not enabled. Higher anisotropic filtering improves the image on highly stretched displays.
- Bi-cubic sampling (DirectX/OpenGL): Uses advanced bi-cubic sampling to improve the image quality for DirectX/OpenGL applications.
- Apply anti-aliasing: Use anti-aliasing techniques to smooth and improve the image quality for desktop warping.
- Force desktop rotation: If checked, user can select the desktop rotation to override the driver provided desktop rotation info. To be used when desktop rotation provided by the driver is not consistent and correct.
- Refresh interval. This value determines how often the configuration screen will be updated. On lower performance computers this value can be set to 50 or 100 ms to prevent freezing if the configuration screen.
- Enable VNC access with VNC password and VNC port. When enabled, a vnc server will be started when the software is running. Users can use any VNC client to connect and configure this PC
- Enable CMDNET interface and CMDNET port. When enabled, a text based TCP server will be started when the software is running. Users can use the CMDNET commands to control some actions of the software. For more information, look at the CMDNET section.

- Custom images folder: This is a folder where the user can store its custom images that can be selected inside the geometrical correction configuration window.
- Image Editor: This button opens the custom image editor. With this editor, users can create custom background images the can be loaded during the geometrical correction and edge-blending process. The images can be created with the same resolution as the resolution of the display. Custom colors, lines, circles, text and other options are available to create a variety of custom images that best suit the calibration purpose.



Additional advanced settings are available to enable and configure the FS9/FSX and Prepar3D edge cropping. FS9/FSX and Prepar3D draw a white edge around the external views. This edge can interfere with the edge blending settings. Using these tab users can configure how the software will crop those edges.
OpenGL texture offset can be used with some OpenGL programs that use textures without first allocating the texture in the OpenGL system. Those textures can interfere with the textures needed for warping and blending. This offset will make sure that the Immersive Display PRO textures are allocated in a range outside of the applications range.
The special option "Force preserve back buffer" is needed when some applications try to use their back buffer even when the back buffer is discarded after presenting it to the projectors.
The enable de-banding option can be used to try to reduce the color banding on some displays when using grayscale of fade images. Some displays will

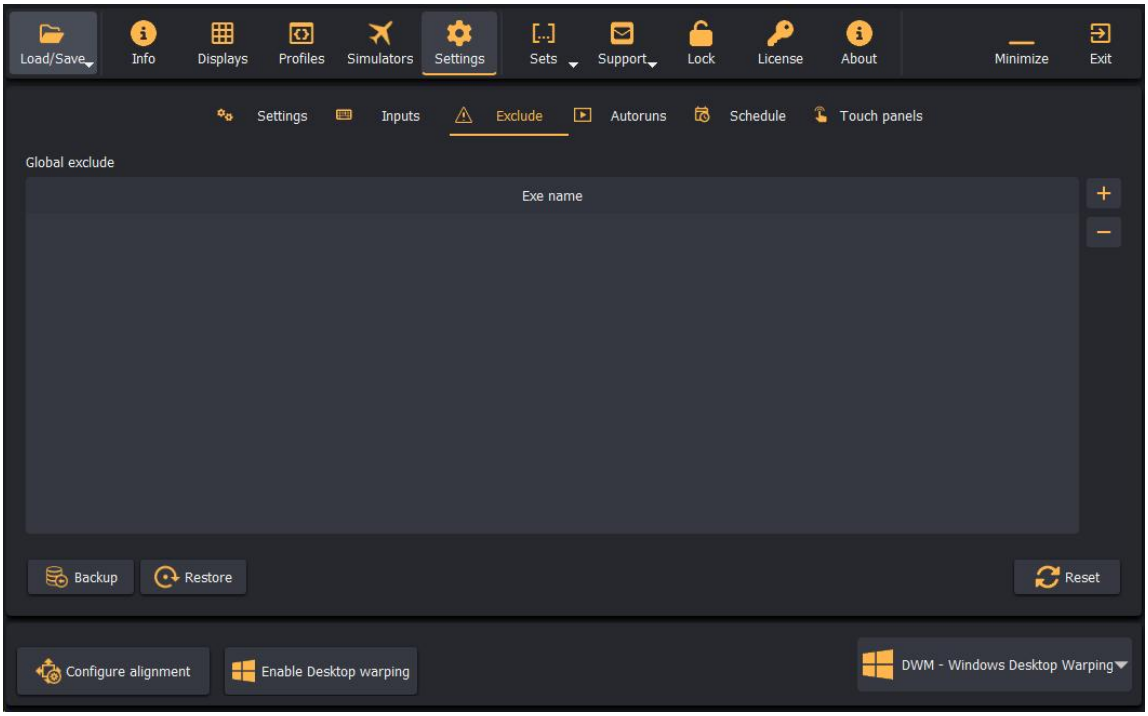
show bands of colors for some images. This can be reduced by selecting this option.



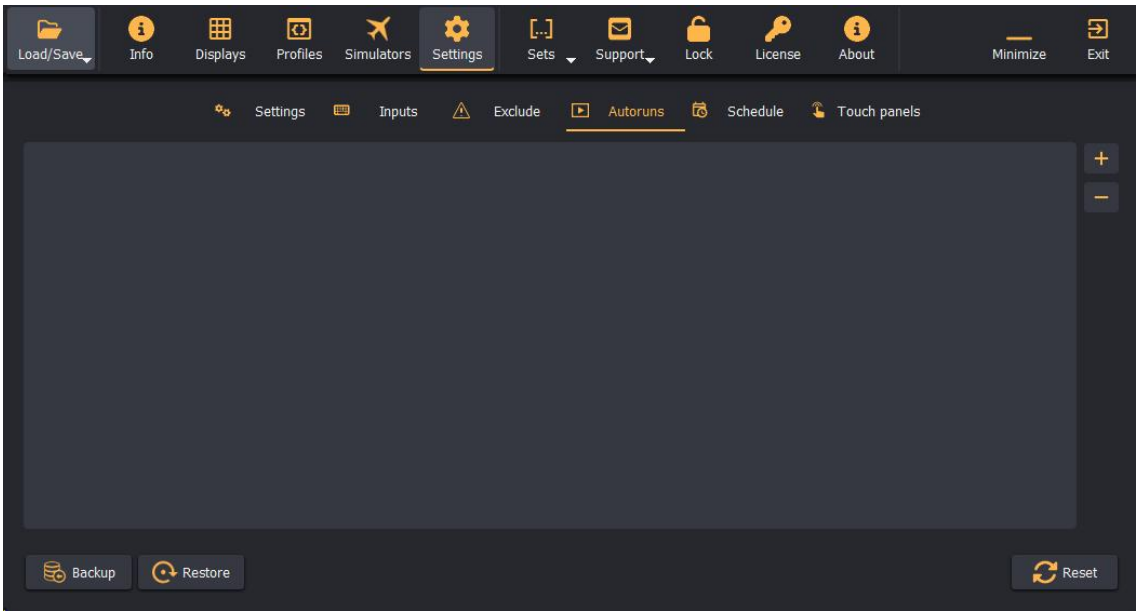
The inputs tab can be used to redefine the standard keyboard shortcuts. The following table shows the default keyboard shortcuts for the config dialog:

Modifiers		Key	Action
		F3	Edit Warp & Blend (Starts the geometrical correction and soft-edge blending editing window for all displays)
Ctrl		F3	Edit Warp & Blend with screenshot (First takes a snapshot of the display and starts the geometrical correction and soft-edge blending editing window for all displays with the snapshot image as the background))
		F4	Toggle window warping (Not available in Immersive Display Desktop)
Ctrl		F4	Toggle desktop warping (Available in Window 7 only)
Ctrl	Shift	1	Select configuration set 1
Ctrl	Shift	2	Select configuration set 2
Ctrl	Shift	3	Select configuration set 3
Ctrl	Shift	4	Select configuration set 4

Ctrl	Shift	5	Select configuration set 5
Ctrl	Shift	6	Select configuration set 6
Ctrl	Shift	7	Select configuration set 7
Ctrl	Shift	8	Select configuration set 8

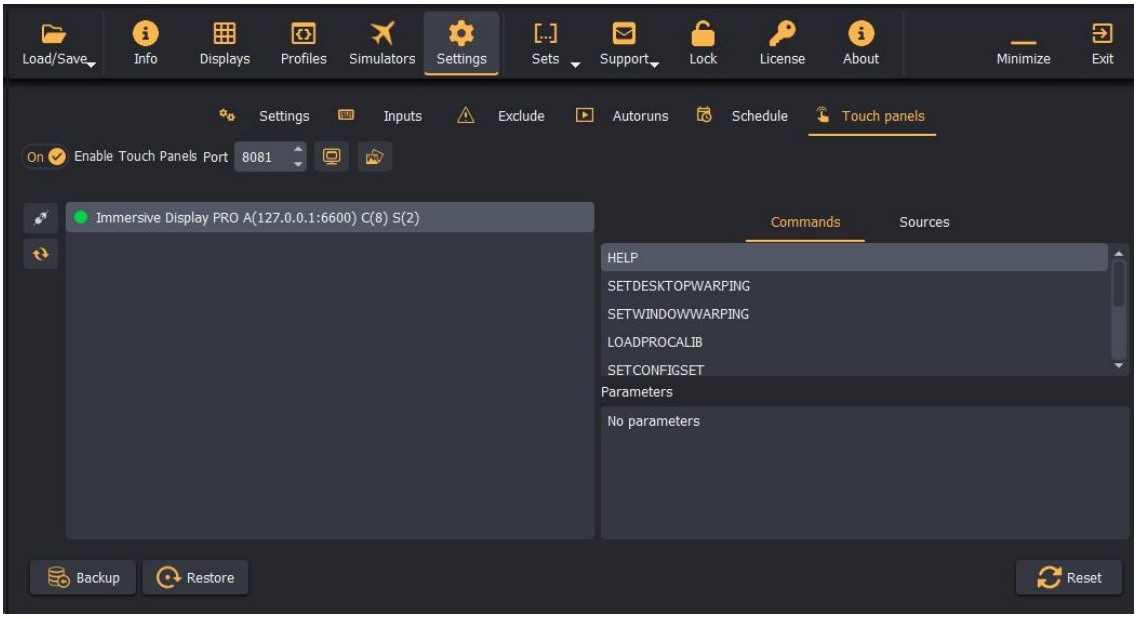


The exclude tab can be used to add or remove programs that should be excluded from warping. Some programs are not designed to be warped and can be put in this list. The software will never apply the warping to those programs.



The Autoruns tab can be used to add or remove programs that should be started automatically when Immersive Display PRO starts. Using these feature users can specify one of more programs to be started automatically during system startup (if Immersive Display PRO is setup to start automatically with system startup) after Immersive Display PRO is started and initialized. Programs that are started before Immersive Display PRO is initialized will not be warped.

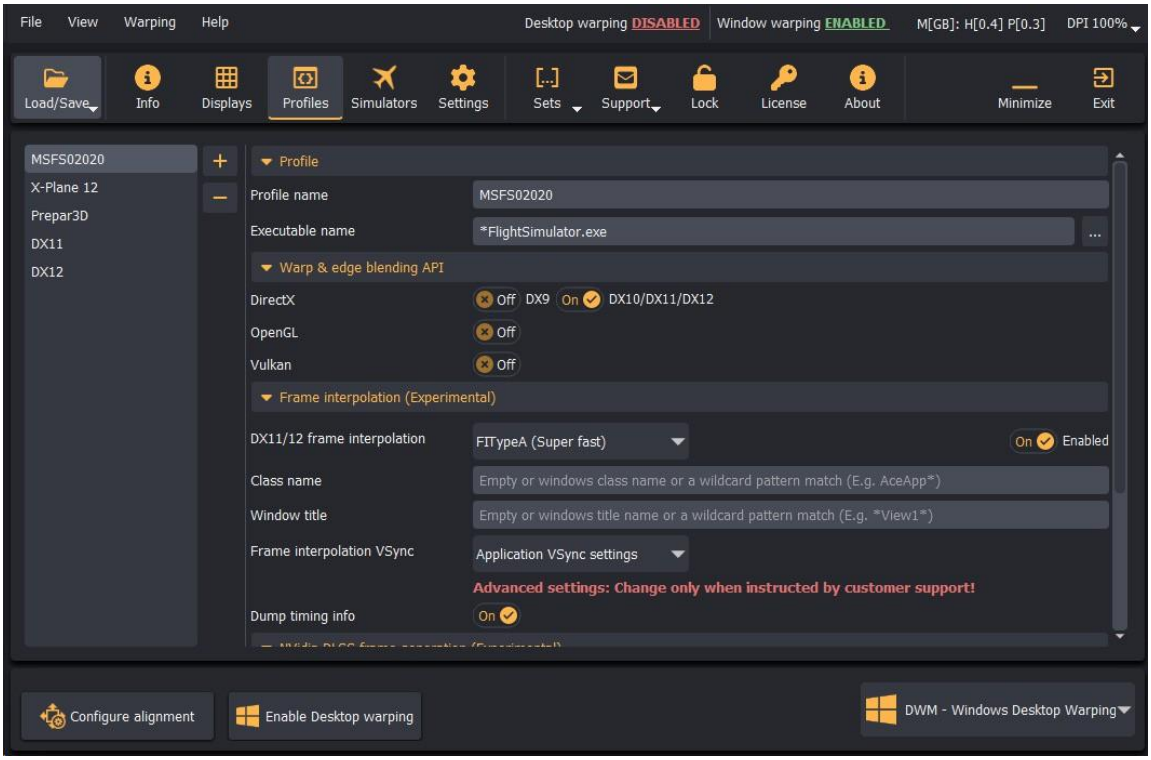
5.3.1 Touch panels



The Ultimate license of the software allows the user to design and use HTML based touch control panes to control the software from a table, mobile phone or any HTTP/HTML enabled device.

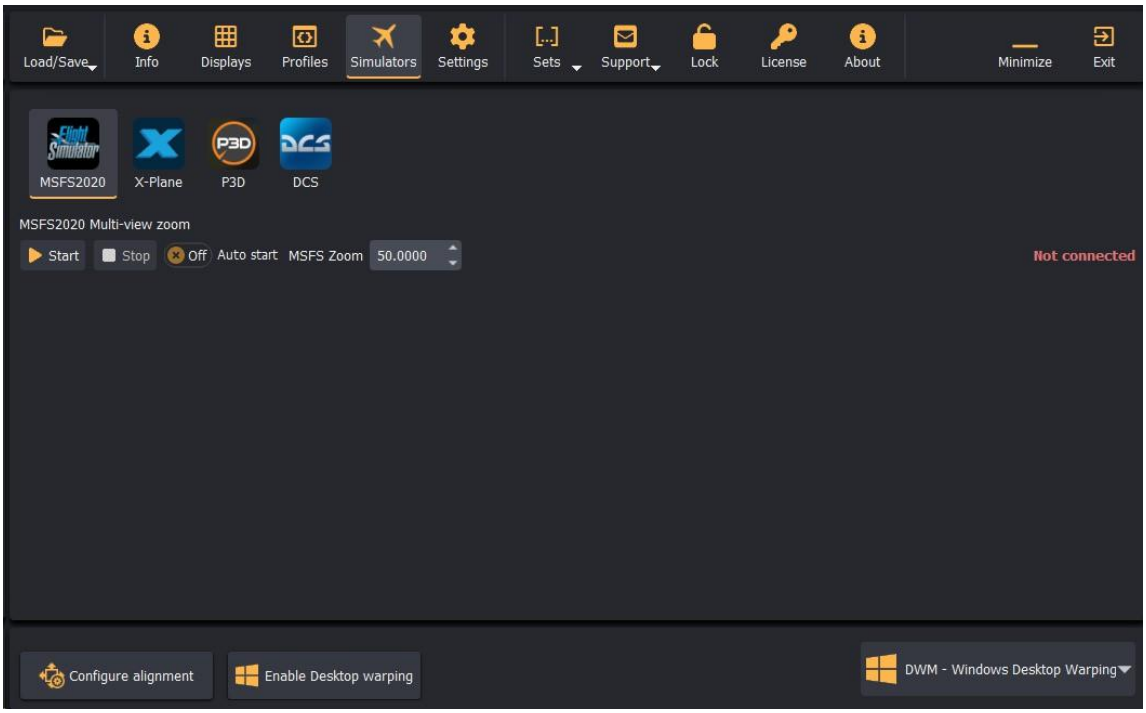
See the TouchPanelsUserManual.pdf document.

5.4 Profiles tab



In the Profiles Tab, a profile can be defined per application.
For each application the executable name can be specified to identify the application.
Per application users can specify which graphics frameworks should be used to apply the warping and blending. OpenGL, Vulkan and DirectX can be specified independently.
Frame interpolation can be specified per application including AI based frame interpolation as well as NVidia DLSS frame interpolation for older NVidia GPUs.

5.5 Simulators tab



The simulator tab can be used to setup different flight simulators. For X-Plane, P3D and DCS, the software offers functionality to load the exported configuration data from Calibration PRO and configure the simulator for multi-view.
For MSFS2020 the exported Zoom settings can be applied to ensure the simulator keeps the calculated zoom.

5.6 Button bar

The button bar contains the following buttons:

- Desktop warping: (Available only on Windows 7, Window 8 and Windows 10). By toggling this button, the user can enable and disable the seamless

integration of the Windows 7, Windows 8 or Windows 10 desktop warping and the individual programs warping in windowed and full screen mode. It is recommended to have this option selected when running on Windows 7 Window 8 or Windows 10.

- Desktop warping mode: The software supports the following desktop warping modes, depending on the available GPU hardware:
    - DWM – Windows Desktop warping. This mode uses the standard windows desktop composition and works on all graphics cards. On Windows 7, AERO must be enabled for this warping mode
    - NVAPI – NVidia Native Warping API. This mode uses the NVidia warping and blending API. This is supported by the NVidia Quadro graphics cards.
    - DOPP – ATI/AMD Native Desktop processing API. This is experimental API and supported by FirePRO graphics cards.

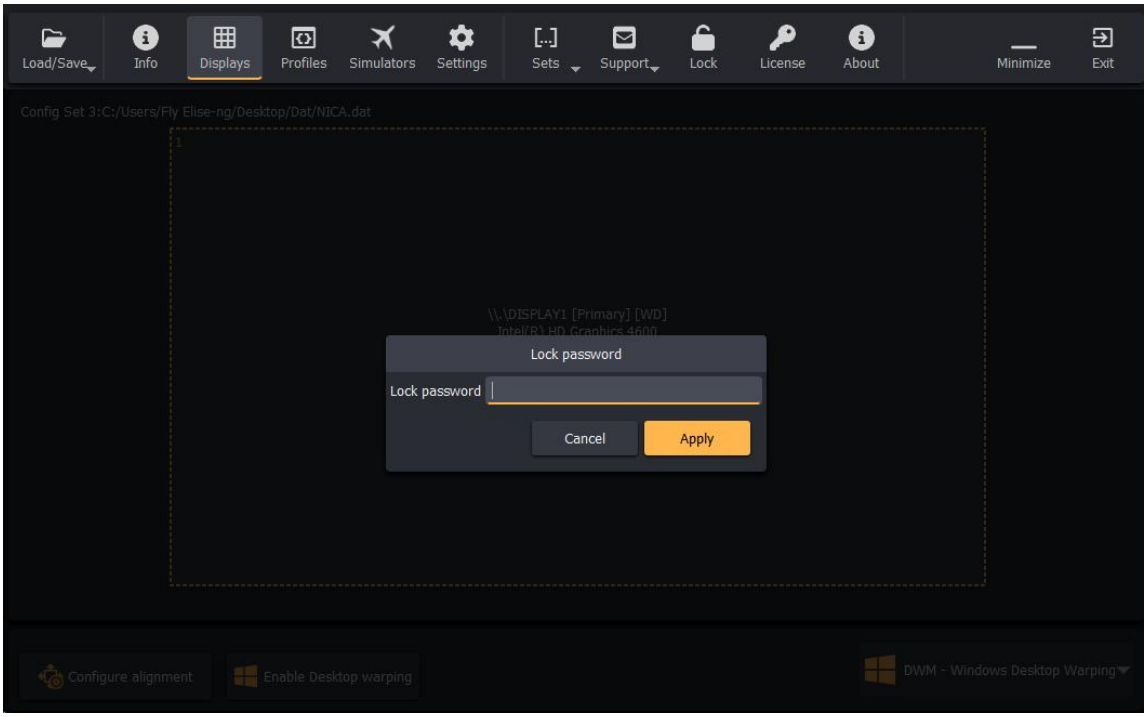
  After selection of the desired desktop warping mode, the software needs to be restarted in order to be able to use the newly selected mode.
  Before enabling one of the Native Warping API (NVAPI or DOPP), make sure that the graphics card and the drivers support it.
  The DWM desktop warping as the most widely used and is supported by all graphics cards.
- Configure: Starts the geometrical correction and soft-edge blending configuration window if one or more displays are configured with projectors configuration.

5.7 Config sets

Immersive Display PRO allows the user to configure multiple configurations that can be loaded at once and can be switched instantaneously. This can be used to have different warping and blending settings for brighter scenes and another blending configurations wit darker scene. Also the user can create one config set with _multi.procalib and another config with _single.procalib for warping multi-view and single view scenes respectively.
The users can switch between one of the 8 possible configurations sets using the default keyboard shortcuts (CTRL+SHIFT+1/2/3/4/…/8). If the game of the screen is warped, the warping will change instantaneously according to the selected configuration.

6 Configuration locking

In cases when the system is running in unattended mode or kiosk mode, it can be desirable to lock the software configuration and prevent any changes in the configuration.
Use the Lock/Unlock button to lock and unlock the configuration.



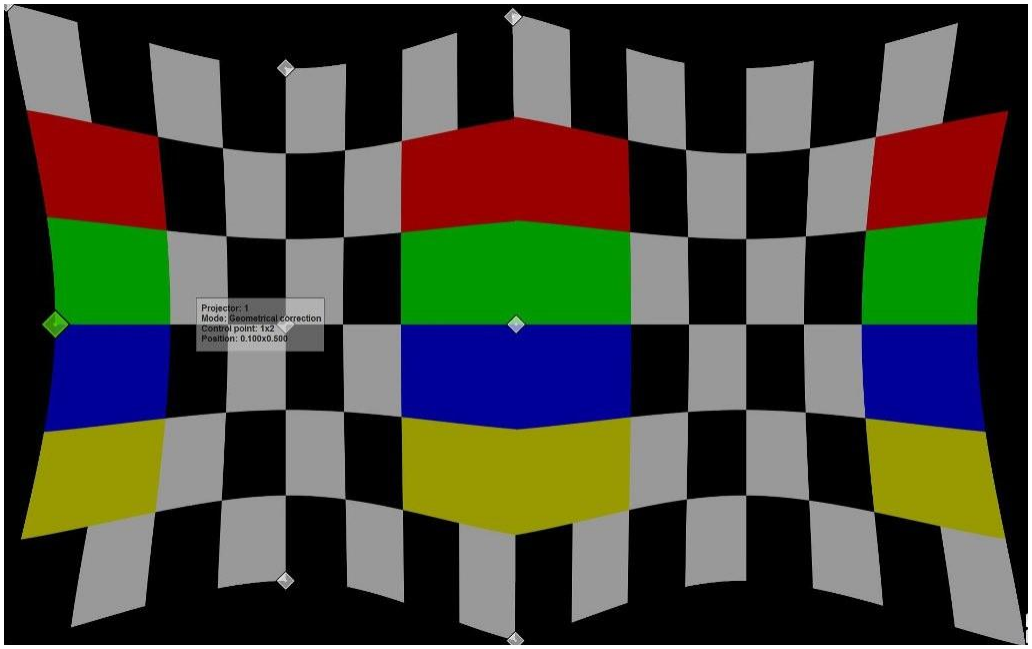
Use a password to lock the configuration and prevent any configuration changes. After that, it is not possible to select projector configuration and to configure the warping and blending.

7 Geometrical corrections and soft-edge blending window

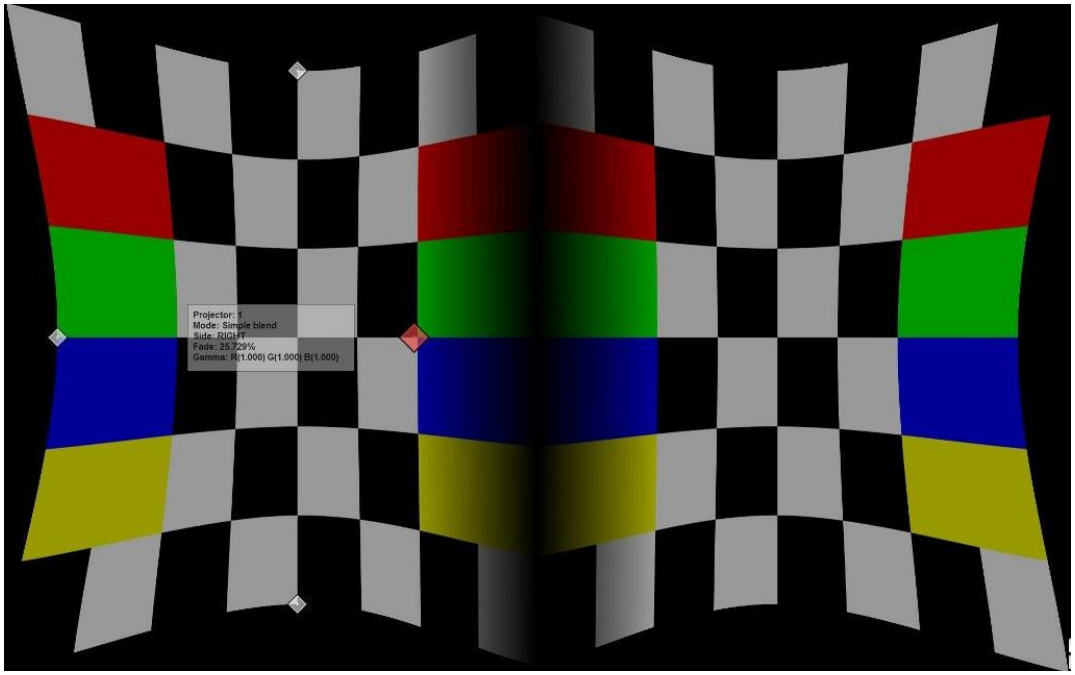
Geometrical corrections and soft-edge blending window provides a warping mesh of control points. By adjusting the position of the control points, the projected display can be mapped on any kind of planar or curved surface.
Depending on the projector configuration, a number of independent meshes are available (one per projector). The control points can be moved by mouse or by using keyboard shortcuts.
The number of horizontal and vertical control points can be selected from the advanced setup dialog or using keyboard shortcuts. Up to 50 control points can be selected.
Three editing modes are available:

- Geometrical correction
- Simple edge blending
- Advanced edge blending

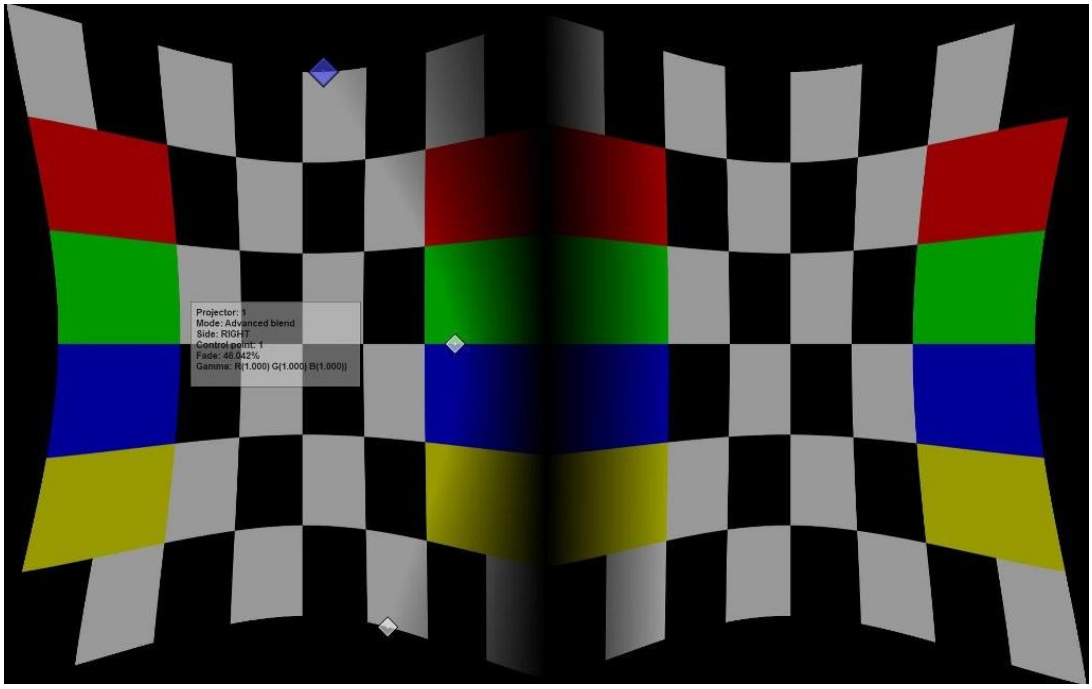
In geometrical correction mode the image can be mapped on any projection surface by dragging the green control points with the mouse or using keyboard shortcuts.



User can switch between geometrical correction and edge-blending mode using the "F10" key.
In simple edge blending mode, one control point is available per edge. User can drag the red control points to adjust the blending regions for each edge. Using the mouse scroll button the gamma value can be adjusted per control point.



Using the advanced configuration dialog user can enable the advanced blending mode.
In advanced blending mode one or more control points can be defined per edge. The blue control points can me moved independently to realize the most complex edge-blending configurations.
Using the mouse scroll button the gamma value can be adjusted per control point.


Projector: 1
Mode: Advanced blend
Side: RIGHT
Control point: 1
Fade: 46.042%
Gamma: R(1.000) G(1.000) B(1.000)

7.1 Keyboard and mouse control

Keyboard shortcuts

Modifiers		Key	Action
		D	Show/Hide advanced configuration dialog
		C	Center the configuration dialog on the projector
		I	Show Hide information window
		Esc	Close configuration dialog and window
		F5	Increase the number of horizontal control points
		F6	Decrease the number of horizontal control points
		F7	Increase the number of vertical control points
		F8	Decrease the number of vertical control points
		N	Select next geometrical correction grid
		Left	Select left control point
		Right	Select right control point
		Up	Select up control point
		Down	Select down control point
Ctrl		Left	Move control point left by 1 pixel
Ctrl		Right	Move control point right by 1 pixel
Ctrl		Up	Move control point up by 1 pixel
Ctrl		Down	Move control point down by 1 pixel
Ctrl	Shift	Left	Move control point left by 10 pixels
Ctrl	Shift	Right	Move control point right by 10 pixels
Ctrl	Shift	Up	Move control point up by 10 pixels
Ctrl	Shift	Down	Move control point down by 10 pixels
		F10	Toggle between geometrical correction and soft edge blending editing
		F11	Toggle between simple and advanced soft edge blending grid
		F12	Select next soft edge blending grid
Ctrl	Shift	Q	Reset all geometrical correction and soft edge blending grids
Ctrl		Q	Reset all geometrical correction and soft edge blending grids to the whole display area

Mouse operations

In geometrical correction mode:

- Drag control point with LEFT mouse button normal drag
- Drag control point with RIGHT mouse button fine grained drag
- Key combinations: "H" - drag all points in the same horizontal line
- Key combinations: "V" - drag all points in the same vertical line
- Key combinations: "A" - drag all points in the grid
- CTRL + S + MIDDLE mouse – Select a region to select all control points in the region
- CTRL + D + MIDDLE mouse – Select a region to de-select all control points in the region
- RIGHT mouse double-click – Select and De-select a control point

In soft edge blending correction mode:

- Drag control point with LEFT mouse button normal drag
- Drag control point with RIGHT mouse button fine grained drag

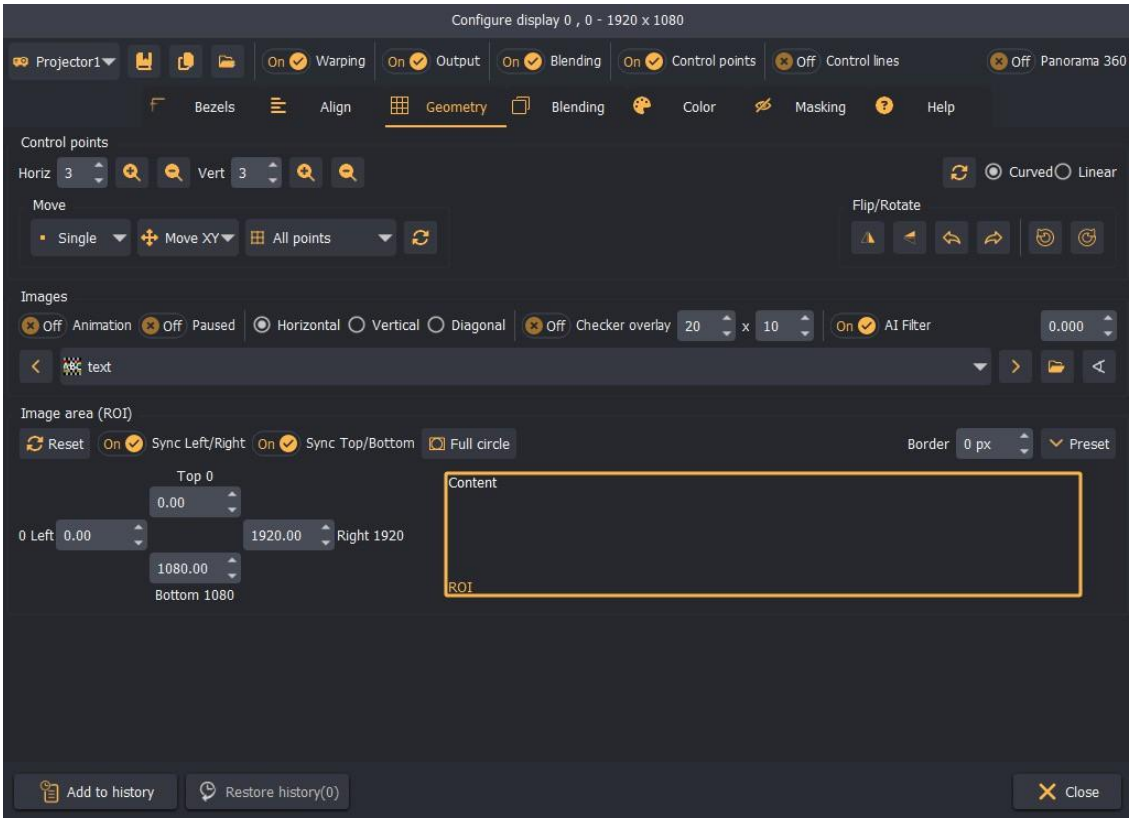
- Mouse wheel: Increase/Decrease the Red, Green and Blue gamma value of the soft edge blending point
- Mouse wheel + Key R - Increase/Decrease the Red gamma value of the soft edge blending point
- Mouse wheel + Key G - Increase/Decrease the Green gamma value of the soft edge blending point
- Mouse wheel + Key B - Increase/Decrease the Blue gamma value of the soft edge blending point

The list of all keyboard and mouse shortcuts keys can be shown in the calibration screen using the "Help" button. A new window will be shown next to the calibration configuration dialog.

7.2 Advanced configuration dialog

Pressing the "D" key can toggle the visibility of the advanced configuration dialog.

Geometrical correction tab



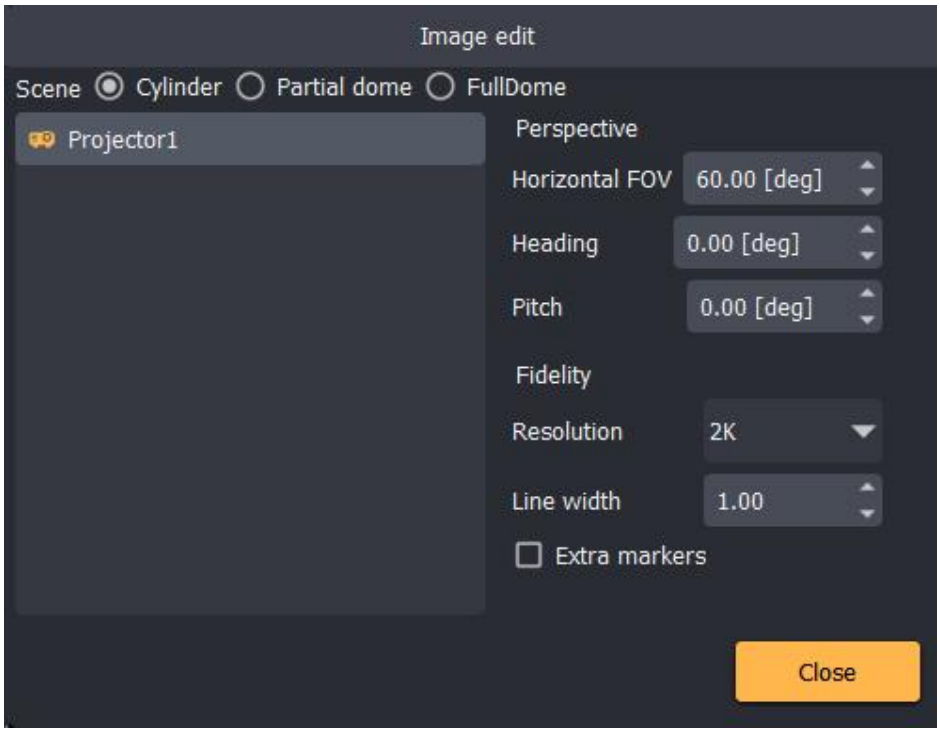
In the geometrical correction tab, the user can:

- Select the projector to be edited
- Enable/disable the projector output
- Show/hide the control points
- Show/hide the lines between the control points
- Select the number of horizontal and vertical control points
- Double or halve the number of horizontal and vertical control points
- Select the curved or linear geometrical correction
- Select to move single control point, all control points in the horizontal or vertical line, selected points or all control points on the grid
- Select to lock the movement in X, Y or XY directions
- Select to move only the edges control points and let the program interpolate the other control points

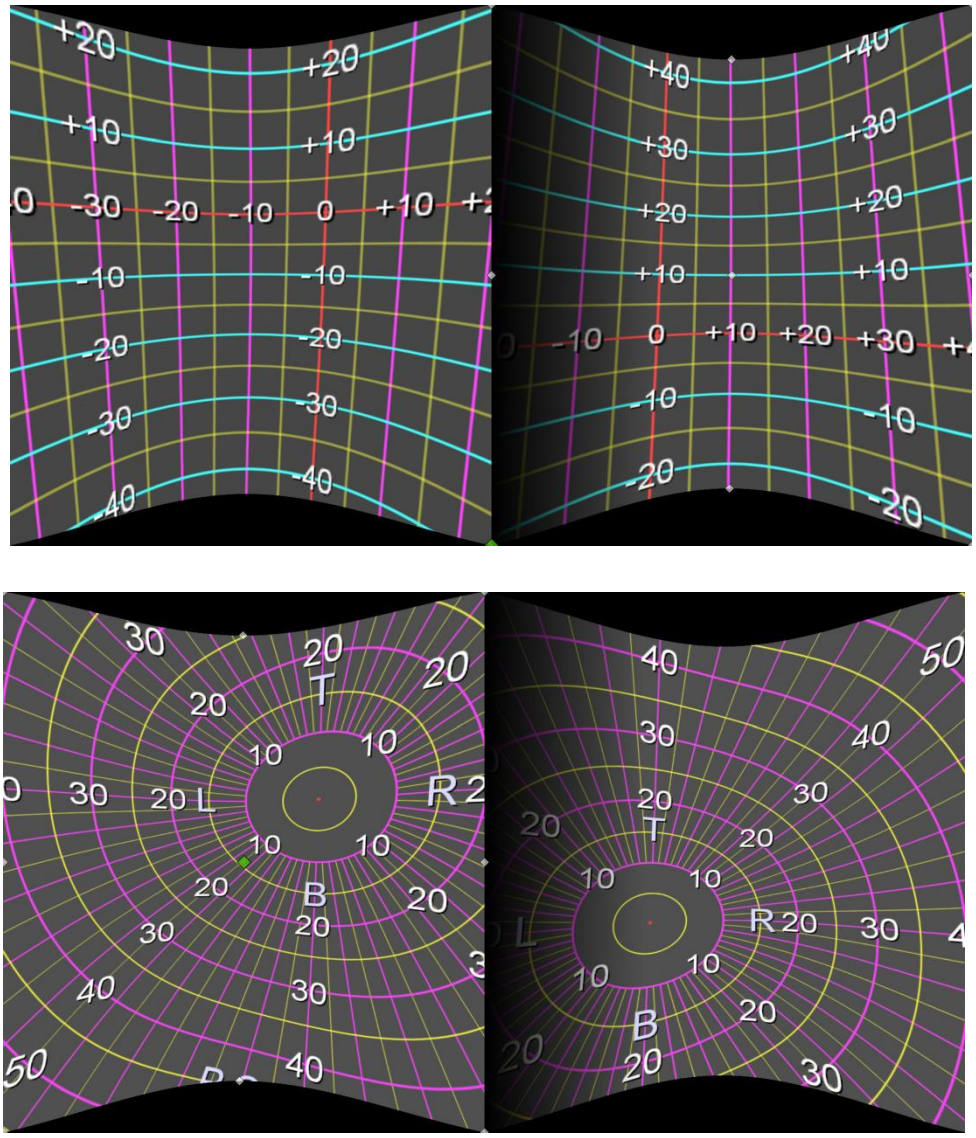
- Enable or disable the horizontal, vertical or diagonal animation lines for perfect geometrical correction
- Add additional checker grid overlay on top of the background image. Configure the number of horizontal and vertical checker boxes.
- Control for image mirroring, flipping and rotation
- Select the background image from the list of the built-in image of customer provided images in the images folder
- Load a background image from any location form the hard disk.
- Create a perspective images as background
- Adjust the image mapping on the screen for perfect aspect ratio.

Perspective background images

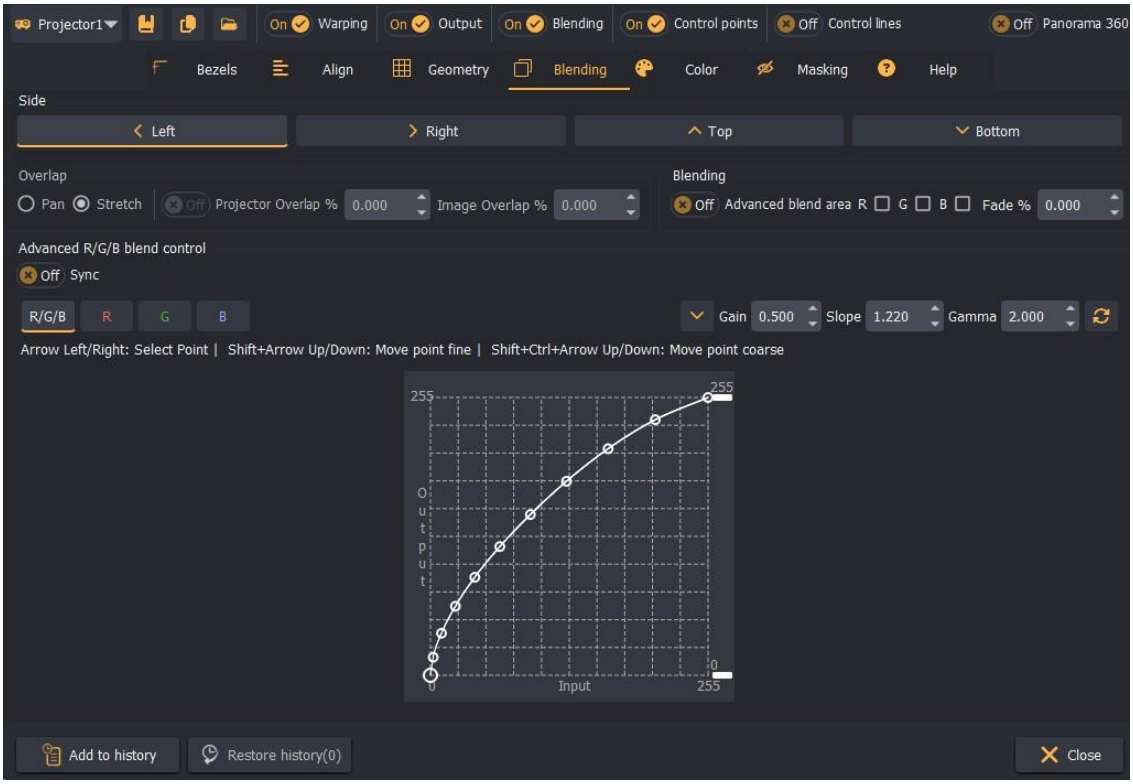
When mapping content from a game engine or another IG which produce images for the projectors from a different perspective camera, the users can create the background images with exactly the same virtual camera parameters and map them accurately on the screen.



The following 3 screen shapes are supported: cylindrical screen, partial dome screen and full dome screen.



Soft-edge blending tab



In the soft-edge blending tab user can:

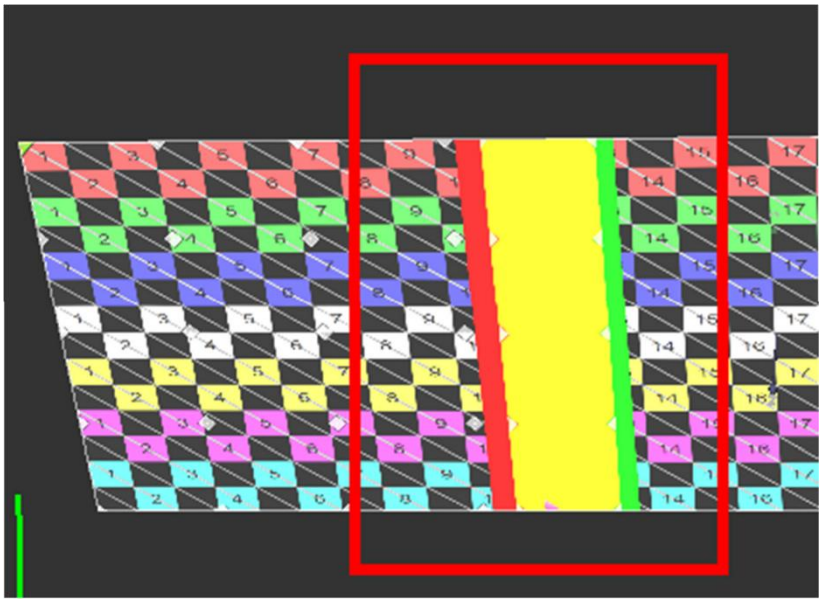
- Select to edit Left, Right, Top or Bottom edge of the projector to edit the overlap or the fade (blend) area.
- Select between pan or stretch overlap mode
- Adjust the overlap region per edge
- Toggle between simple and advanced soft edge blending mode
- Adjust the fade region per edge (available only in simple edge-blending mode)
- Adjust the fade ramp per component R/G/B or for all components simultaneously.
- Use a parametric formula to configure the fade ramp based on 3 parameters (gain, slope, gamma).
- Manually fine-tune the fade ramp using the advanced fade controls.
- Select the masking bitmap that can be applied to the projectors.

Note: When putting the cursor on top of an adjustable field, a small window will be opened with one or two horizontal sliders. The first slider is for normal change of the value. The bottom slider is for very fine change of the value.

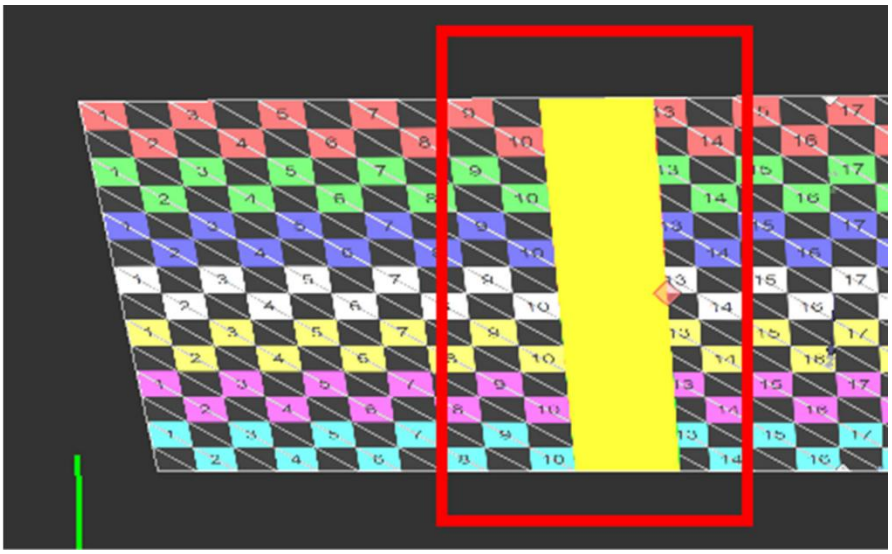
This is a very convenient input method that allows the users quick and fine adjustment of the blending parameters.

The overlap can be configured either as a projector overlap or as an image overlap. When the check box next to projector overlap is checked, the user can enter the projector overlap in percentages. This value should match the actual overlap of the projected images on the projection screen. When overlap is configured for that edge, the projected image will contain also part of the image projected from the adjacent projector. Both images must be matched on the projected screen. When using projector overlap, the overlap of the adjacent projector is automatically updated and the image overlap is automatically calculated.
Using the projector overlap is the preferred way of calibrating the overlap and produces the best results for manual calibration.

Note that, due to the limitations of the graphical system, the overlap region should be set only to projectors connected to the same display. For projectors connected to other display, the output of the displays has to be configured in such a way that both displays show an overlapping image.
Fade is configured as percentage of the total projector image. This is a region whiting which the color intensity of the individual Red, Green and Blue components will fade to black for achieving seamless soft edge blending.
The width of the fade region is very important for achieving good soft edge blending results. Before setting the fade ramp of the fade regions per projector users can select the red color of the of the fade region of the left part of the overlapped edge and select green color on the neighboring projector on the same overlap edge. A combination of green and red color will produce yellow color on the screen. Using the fade regions control points users should adjust the fade region per projector so that no red of green areas are visible outside of the yellow regions.



Fade regions wider than the actual projector overlap.



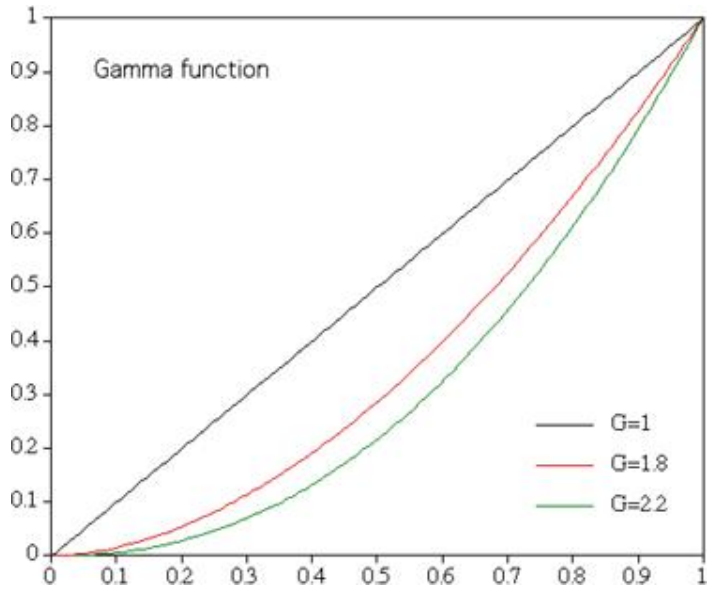
Once this alignment is completed, the fade regions color should be turned off and users can proceed to configure the fade out parameters.

This region can be configured using a parametric formula or manually. In manual mode this region is divided in 10 segments. The intensity of the color components and the beginning of the segments can be adjusted with the vertical sliders. The values inside the segments are interpolated.

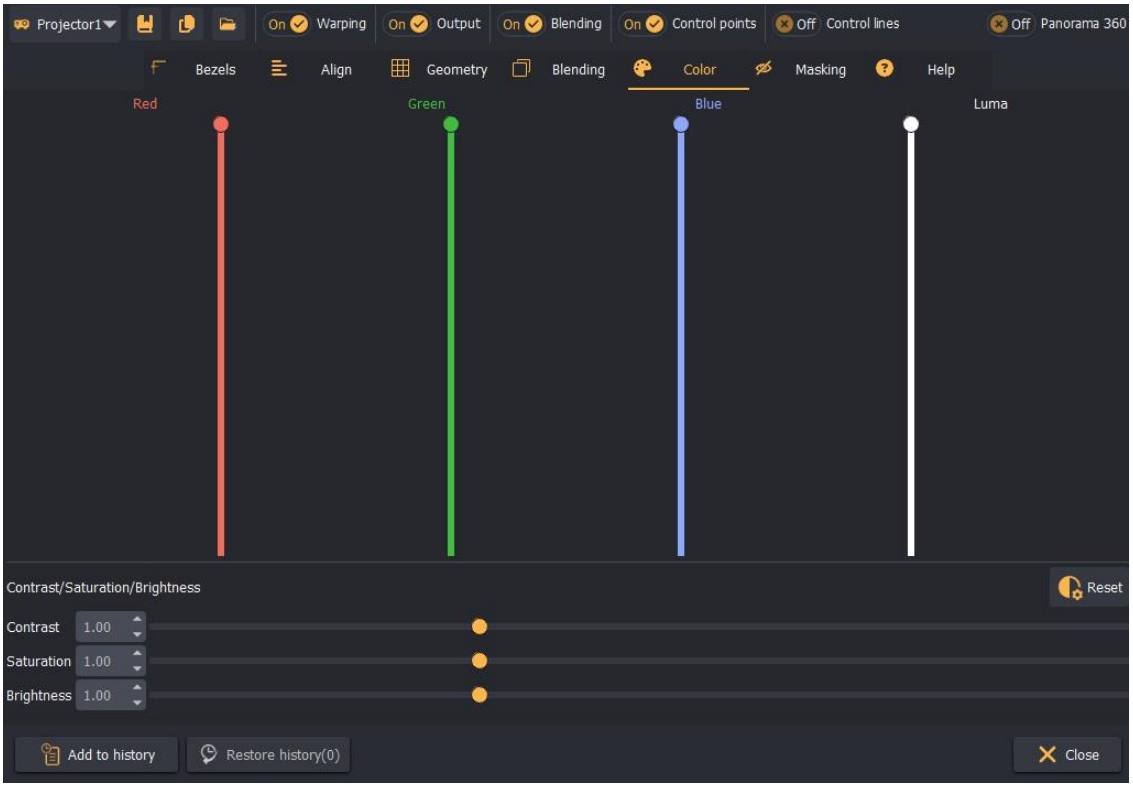
In parametric formula mode the three parameters (gain, slope and gamma) can be used to create the desired fade function profile. The gain and the slope

parameters determine the shape of the fade curve while gamma determines how fast the color will fade to black. The parametric formula can be adjusted per Red, Green and Blue color components or for all components together (Luma).

The following figure shows three gamma functions depending on the gamma value.

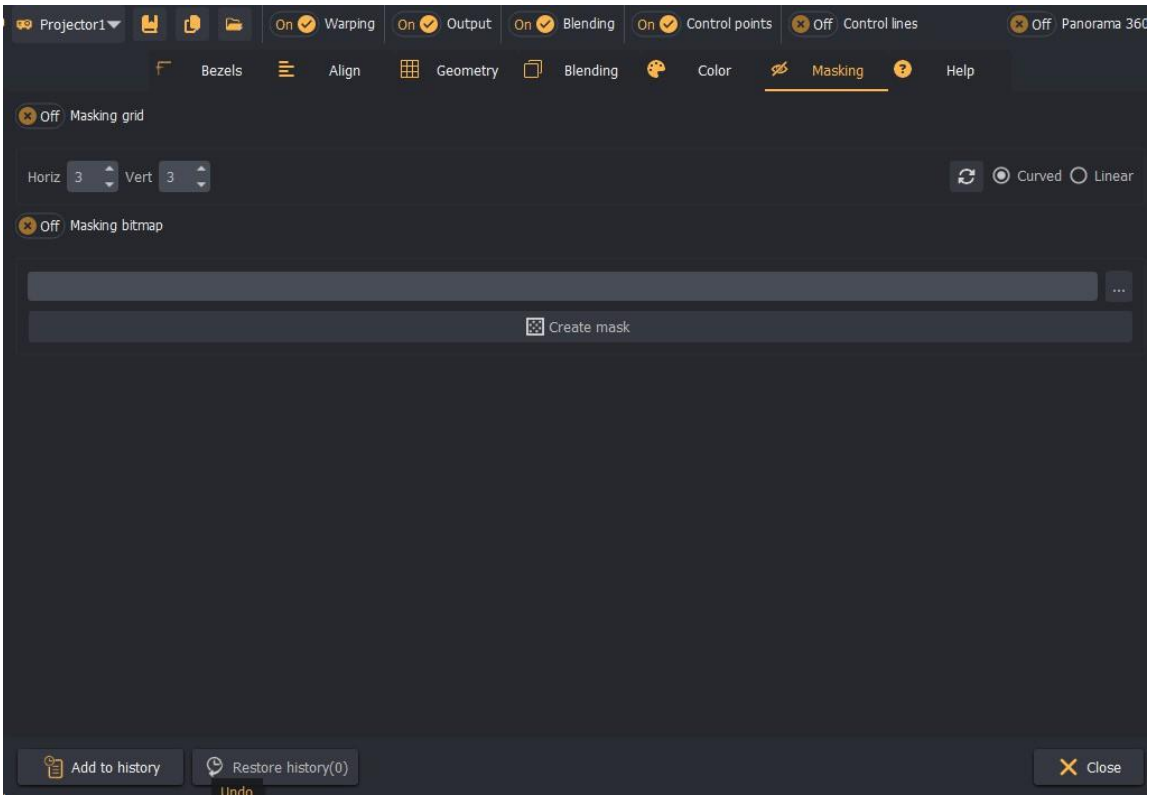


Color balancing tab



In the color-balancing tab the user can adjust the color profile per projector in order to achieve color uniformity among projected images.

Masking tab

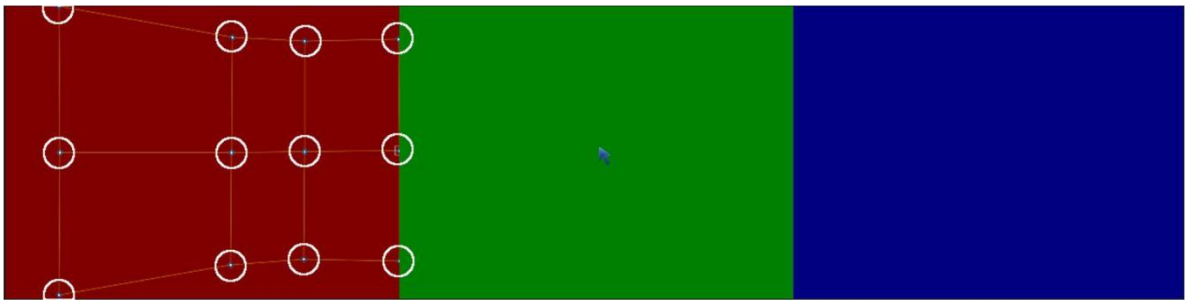


In the masking tab the user can select different masking options per projector or for the whole display.
When a part of the projected image has to be masked for whatever reasons the users can use the masking controls. Masking can be defined in two ways: An interactive masking grid per projector or a masking bitmap per display.
In the masking grid mode, user can use the grid control points in the similar way as with geometrical correction grids. The shape of the grid will determine which part of the image will be visible and which parts will become invisible and will be masked.
User can select the number of the horizontal and vertical grid control points as well as the mode of the grid: curved edges or linear edges.
In the masking bitmap mode, the user can select an existing black & white .bmp or .png file. The file can be prepared offline using a paint program.
The black parts of the image will determine which part of the projected image will be masked and will not be displayed.
Only one masking control can be selected at a time. When no masking control is selected the masking will not be applied.

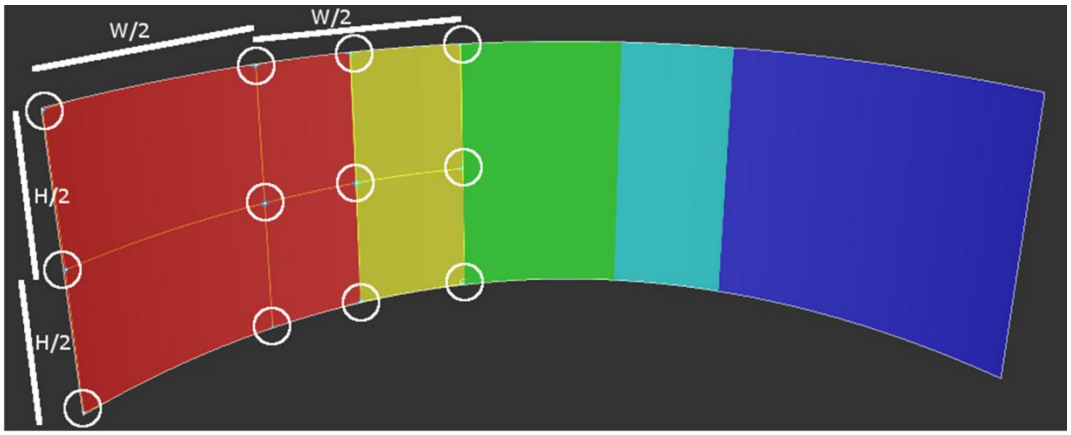
Align tab

Using the Align tab user can use the align grid to indicate the position of the projected image on the screen as well as indicate the overlap regions on the screen with other projectors. By pressing the "Automap" button, Immersive Display PRO will calculate the geometrical correction, the overlap region and the edge blend region to produce the combined mapped image on the screen. This function is a utility function to map the projected image on the screen as accurate as possible using the align grid before the user can continue with the fine-tuning of the geometrical correction and the soft-edge blending.

The users have to position the grid points on the projector so that the points will be shown on the edges of the screen and the edges of the overlapping regions with other projector.
If the projector has one overlapping edge the grid contains only point for the screen edges and the one overlapping edge region. For projectors that have overlapping edges with more projectors (horizontally or vertically) the grid will contain points for all the overlapping regions.
The "colors" background image can be selected during mapping of the align grid for the best identification of the overlap regions.

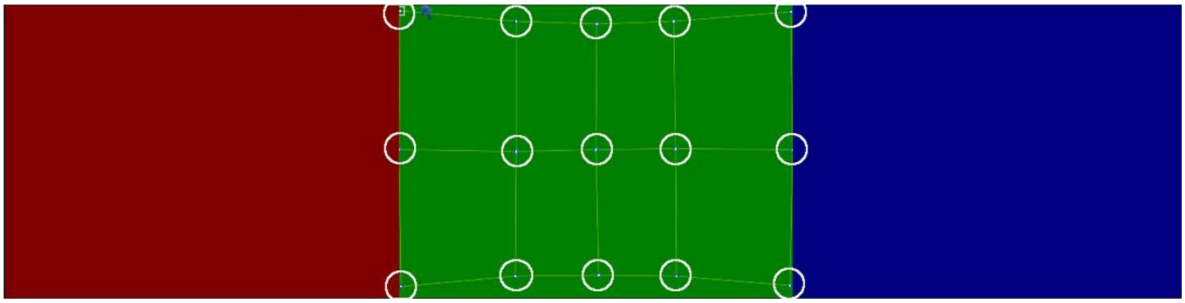


Left projector align points

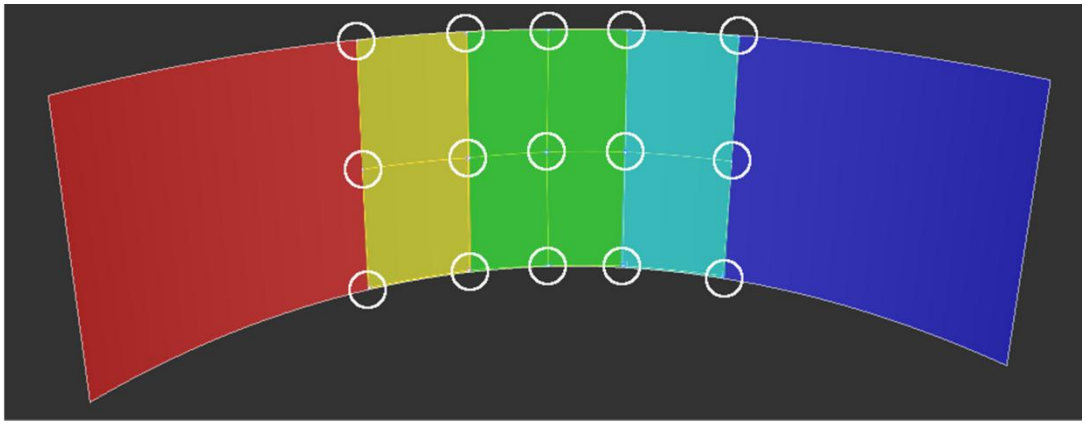


Left projector align points on the screen

A left projector in 3x1 projector configuration the first column of align grid points should be mapped to the left edge of the screen. The second column of the align grid should be mapped in the middle of the projected image on the screen for this projector. The third column should be mapped on the left edge of the overlap between the left and the center projector. The forth column should be mapped on the right edge of the overlap between the left and the center projector.



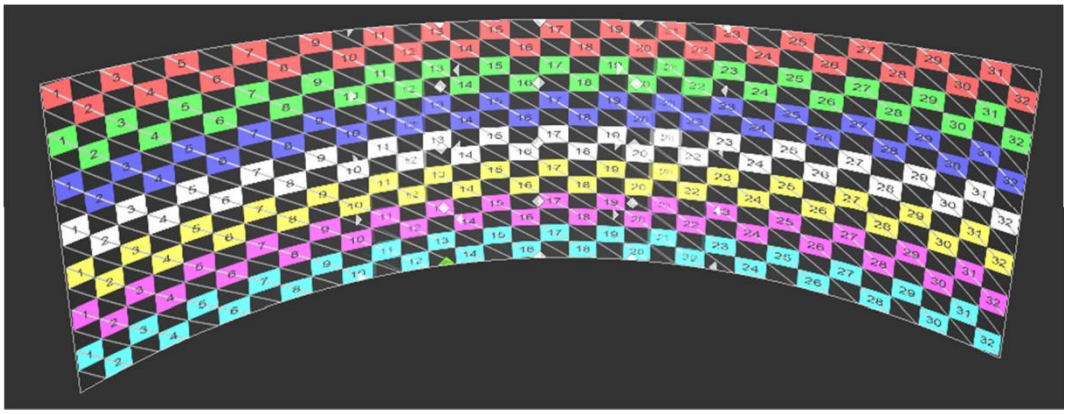
Center projector align points



Center projector align points on the screen

Similar to the left projector the center projector has align grid points for the both overlaps with the left and the right projector. The most left columns of the align grid should be aligned with the overlap region with the left projector. The rightest columns of the align grid should be aligned with the overlap region with the right projector.

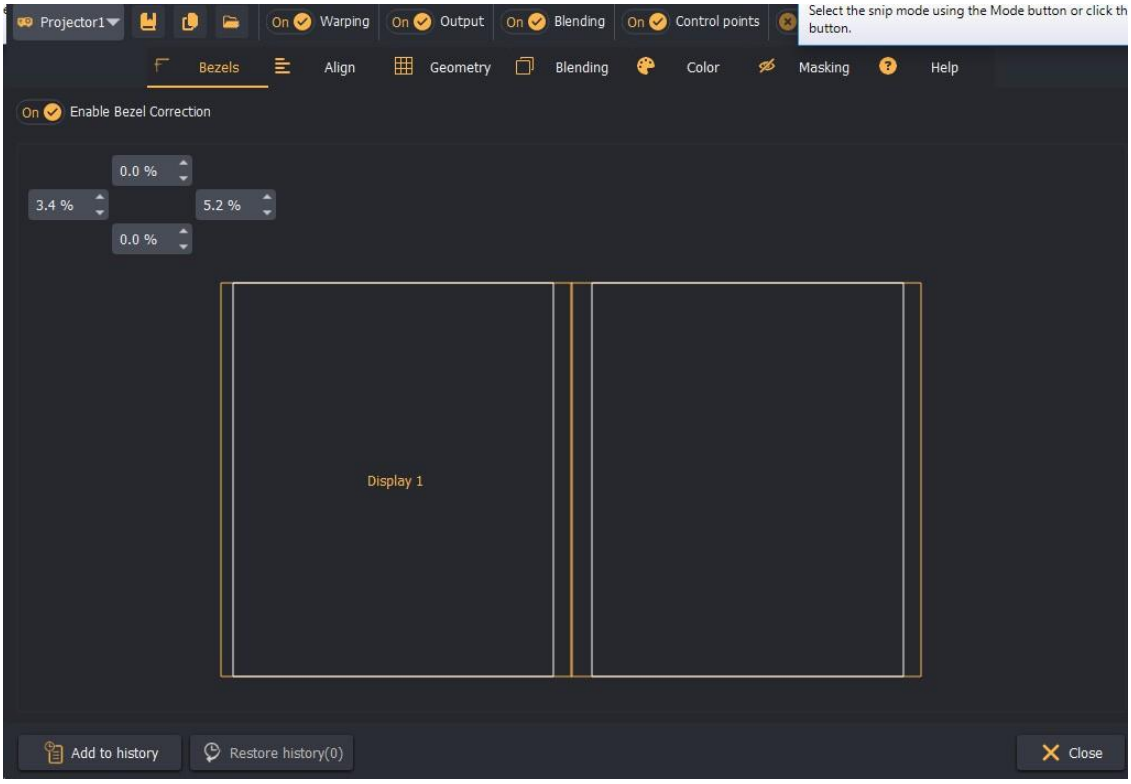
The align grid mapping for the right projector is similar to the left projector. After pressing the "Automap" button the warping approximation will be calculated and applied.



Only small adjustments of the geometrical correction and the edge blending are needed to get the perfect multi projector projection.

Bezel correction tab

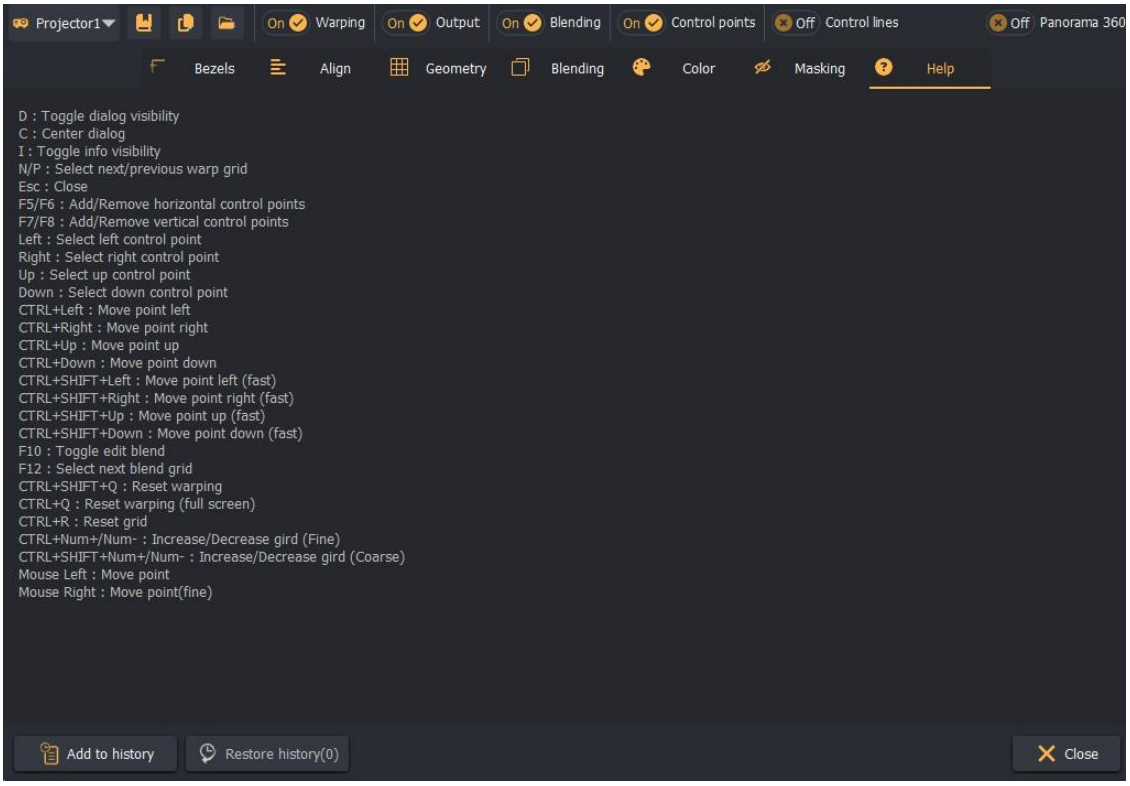
Bezel correction is a new feature in Immersive Display PRO. Users can use this feature to correct the images and compensate for the displays bezels when using large tiled displays.



Some graphics cards a drivers do not support fine grained bezel correction. Immersive Display PRO supports fine grained bezel correction. For each display, users can specify the percentage of the bezels on each edge of the display.
When bezel correction is enabled, other geometrical corrections are disabled and not applied.
Desktop warping must be enabled to apply the bezel corrections.

Keyboard and mouse shortcuts help window

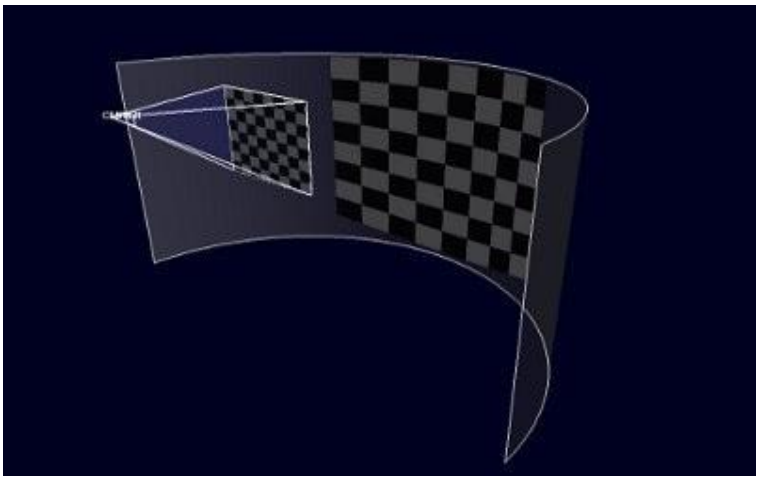
Pressing the "Help" button in the advanced configuration dialog will open the keyboard and mouse shortcuts help window. This help window shows all available keyboard and mouse shortcuts to manipulate the warping and blending.


Projector1
On Warping
On Output
On Blending
On Control points
Off Control lines
Off Panorama 360
Bezels
Align
Geometry
Blending
Color
Masking
Help
D : Toggle dialog visibility
C : Center dialog
I : Toggle info visibility
N/P : Select next/previous warp grid
Esc : Close
F5/F6 : Add/Remove horizontal control points
F7/F8 : Add/Remove vertical control points
Left : Select left control point
Right : Select right control point
Up : Select up control point
Down : Select down control point
CTRL+Left : Move point left
CTRL+Right : Move point right
CTRL+Up : Move point up
CTRL+Down : Move point down
CTRL+SHIFT+Left : Move point left (fast)
CTRL+SHIFT+Right : Move point right (fast)
CTRL+SHIFT+Up : Move point up (fast)
CTRL+SHIFT+Down : Move point down (fast)
F10 : Toggle edit blend
F12 : Select next blend grid
CTRL+SHIFT+Q : Reset warping
CTRL+Q : Reset warping (full screen)
CTRL+R : Reset grid
CTRL+Num+/Num- : Increase/Decrease gird (Fine)
CTRL+SHIFT+Num+/Num- : Increase/Decrease gird (Coarse)
Mouse Left : Move point
Mouse Right : Move point(fine)
Add to history
Restore history(0)
Close

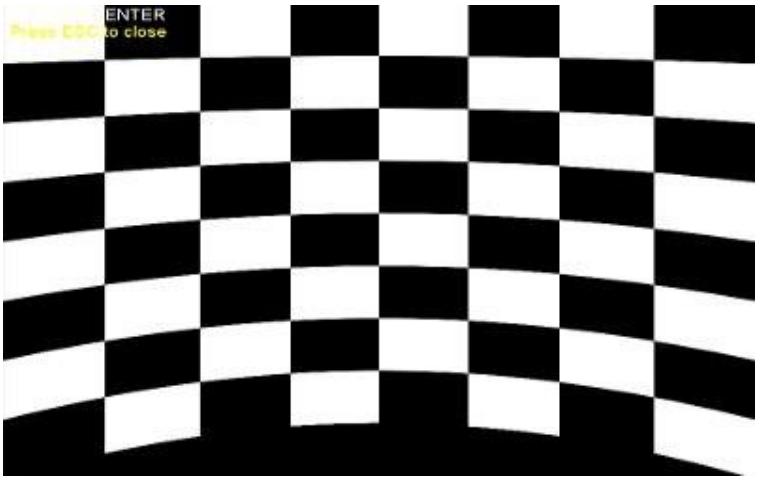
8 Warping and soft-edge blending info

8.1 Image geometrical correction (warping)

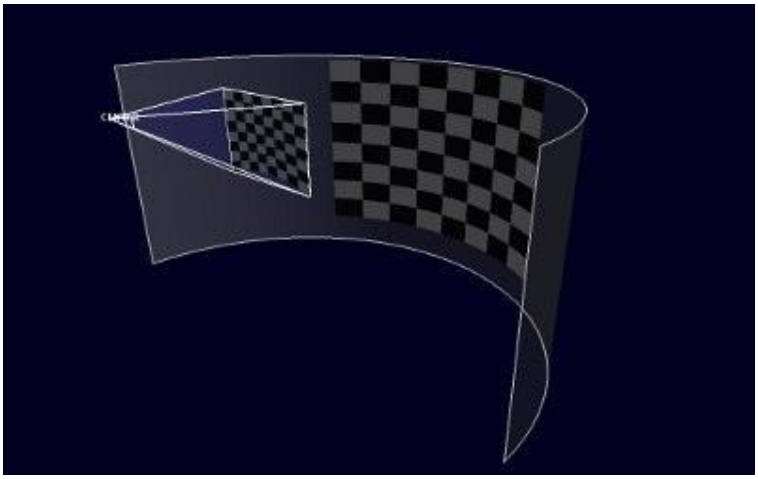
When a computer generated image is projected on a non-planar surface, the projected image will look distorted due to the fact that the projectors are designed to project on planar surfaces. In order to compensate for this distortion, an "inverse" distortion can be applied on the computer generated image. When such an image is projected to a non-planar surface, the image looks corrected.
Depending on the position of the projector and the dimensions of the projection screen, the image on the projection screen does not follow the screen lines.



The projected image can be geometrically corrected (warped) before sending the image on the graphical output. The corrected images look distorted on a planar surface.



When this image is projected on a curved projection screen the projected image will follow the lines of the projection screen and will look undistorted.



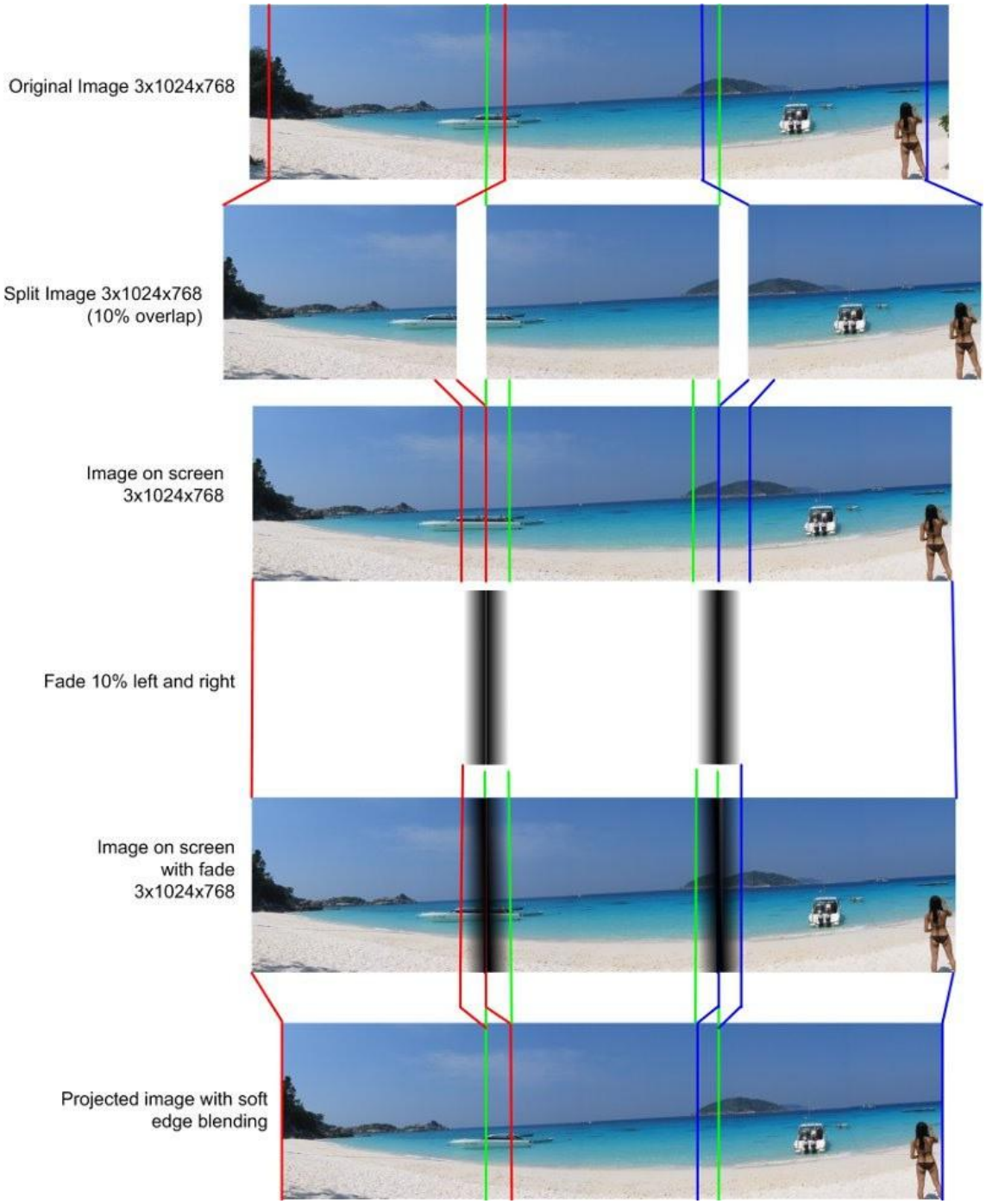
8.2 Soft-edge blending

If multiple projectors are used, the images from two or more projectors can overlap. In this case, soft-edge blending techniques can be used to fade the overlapped images and provide a seamless transition from one image to another.

Soft edge blending can be done using two methods **pan** and **stretch**.

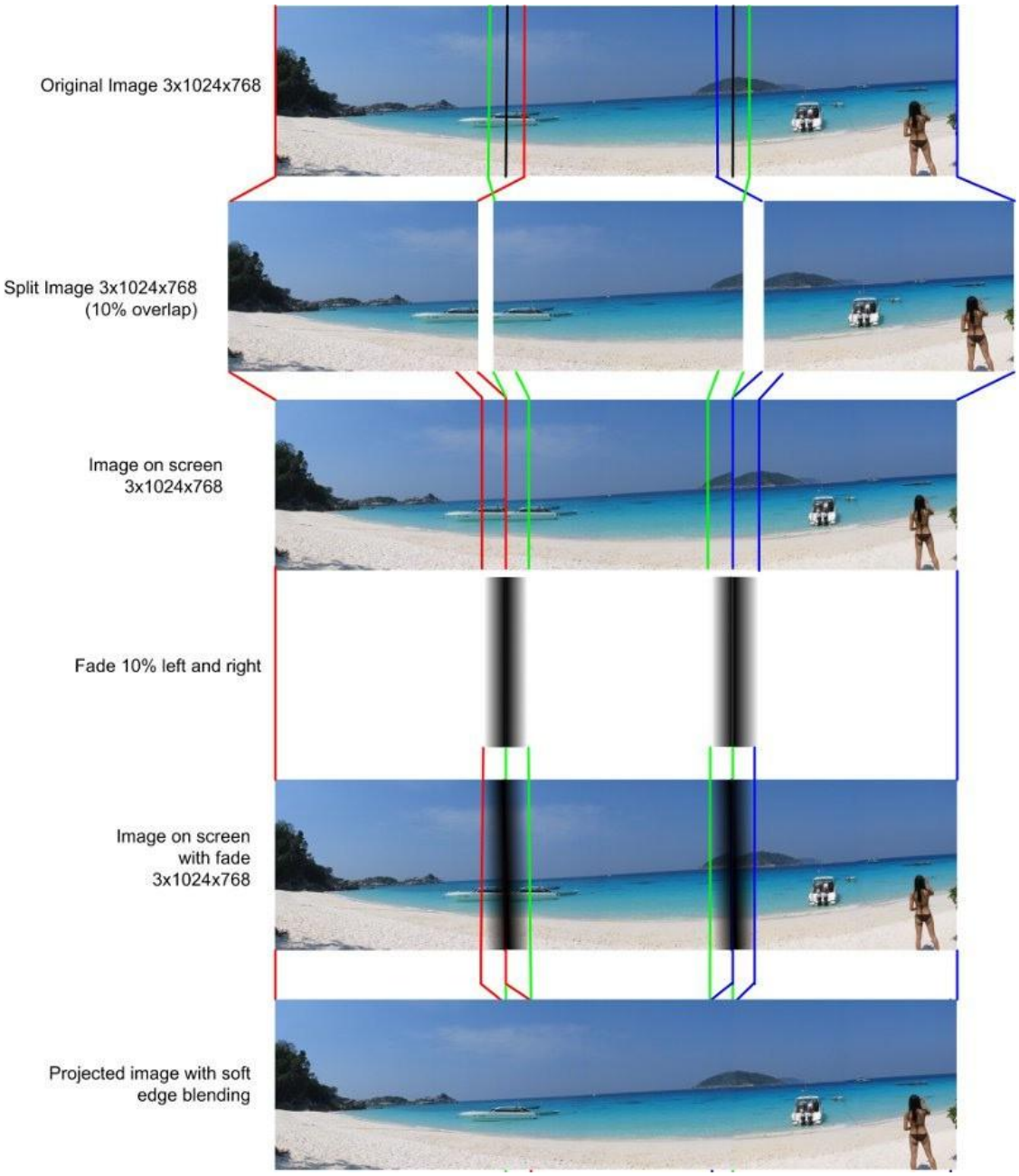
Using the pan method, the overlap regions are created by panning the original images. In this case, part of the original image is lost due to the overlapped

regions, but the aspect ratio of the image stays unchanged. The following image shows the pan soft-edge blending steps.



Using the stretch method, the overlap regions are created by stretching the original images. In this case, the size of the original image stays the same

independent of the overlapped regions, but the aspect ratio of the image is changed. The following image shows the stretch soft-edge blending steps.



9 External camera assisted calibration

The manual geometric correction and soft-edge blending can be completely automated by using a standard off-the-shelves webcam. A HD webcam is recommended for the best results (Ex: Logitech Webcam PRO 9000, Logitech HD Pro Webcam C920, etc.)

The external program ***Immersive Calibration PRO*** should be used to perform the automatic calculation of the geometric correction and soft-edge blending. After ***Immersive Calibration PRO*** has finished, the calculation results should be saved to a file "*.camcalib".

Immersive Display PRO can import this file by selecting "External calibration" menu from the projectors calibration drop-down menu of the display.

After the external calibration file is loaded, users cannot perform further manual geometrical correction. Users can still manually adjust (fine-tune) the soft-edge blending parameters and the black offset parameters.

Note: "Ultimate" licensing option is required to be able to use Immersive Calibration PRO files in Immersive Display PRO

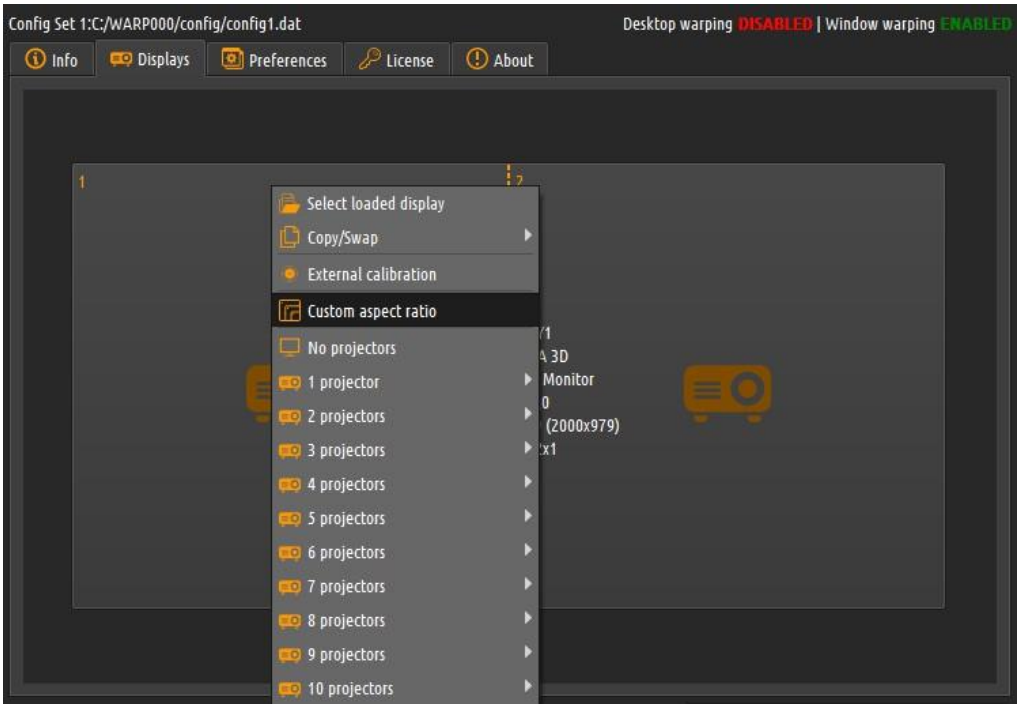
10 Nvidia Quadro native warp and blend support

Immersive Display PRO supports the NVidia Quadro native warp and blend features. The NVidia native warping & blending features are supported for NVidia's high-end and ultra-high-end Workstation Graphics Processors: Quadro 5000, Quadro K5000, Quadro K6000 and Quadro Plex 7000, or all other NVidia Graphics Processors which support NVidia native warping.

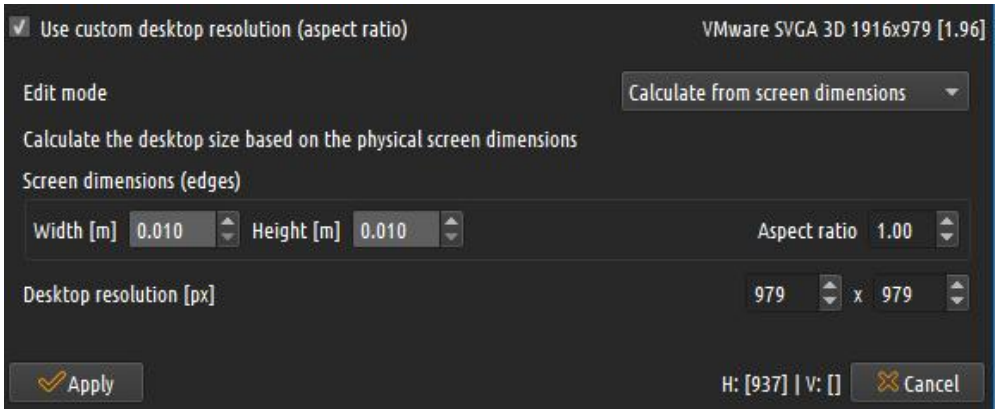
Using the NVidia mosaic technologies users can create the following projectors configuration with one or more NVidia Quadro K5000 graphical cards

- 2 projectors: Single NVidia K5000
- 4 projectors: Single NVidia K5000
- 8 projectors: Two NVidia K5000+SLI or Two NVidia K5000+Quadro Sync
- 12 projectors: Tree NVidia K5000+Quadro Sync
- 16 projectors: Four NVidia K5000+Quadro Sync

When using NVidia Quadro Mosaic, the user can adjust the native desktop resolution to match the aspect ratio of the projection screen. This way, the software will perform optimal fit of the desktop surface to the projection surface, without doing unnecessary image stretching. The aspect ratio of the desktop image will 100% match the aspect ratio of the projection surface.
Using the display context menu select the item “Custom Aspect Ratio”.



In the "Custom Resolution" Dialog user can select to enter the sizes of the projection screen and the aspect ratio and the custom resolution will be automatically calculated.



By selectin the Advanced mode, user can manually enter the desktop resolution to match the projection screen size.

In both cases the needed settings will be calculated to make sure when the desktop warping is enabled in NVidia Quadro Native warping mode, the desktop resolution will be adjusted to match the projection screen.

11 CMDNET interface

CMDNET is a TCP based interface with clear - text commands and responses. This interface allows simple integration of the software with any (show) control software that supports text based TCP control interface.
The CMDNET server waits for requests and then services them as it receives them, in the order they are received. It responds to each request indicating whether the request was carried out, and sometimes to provide requested information. The CMDNET server will only send a message to the client in response to a request. Exactly one message is sent by the CMDNET server to the client in response to each request.

All commands and responses are sent in plain ASCII-encoded text. No data is sent in binary form.
Each command has the following structure:

<COMMAND_NAME> <PAREMETER>;

The command name comes first, followed by an optional command parameter (zero or one). The command and the parameter are separated by a "space" character. A semicolon always ends the command.

Each command is processed by the CMDNET server and response is produced.
The response has the following structure:

<RESULT_CODE>:<RESULT_INFO>;

The result code comes first, followed by result information. The result code and the result info are separated by a ":" character. A semicolon always ends the response.
The result code is one of OK or ERR. OK indicates successful command execution. ERR indicates failure to execute the command.

The following is a list of the supported commands:

11.1 HELP

Description	Lists all available CMDNET commands
Command	HELP;
Response	OK:HELP,GETDESKTOPWARPING,SETDESKTOPWARPING,GETWINDOWWARPING,SETWINDOWWARPING,LOADPROCALIB,SETCONFIGSET,QUIT;

11.2 GETDESKTOPWARPING

Description	Get the status of the desktop warping
Command	GETDESKTOPWARPING;
Response	OK:ENABLED; OK:DISABLED;

11.3 SETDESKTOPWARPING

Description	Enables of disables the desktop warping
Command	SETDESKTOPWARPING ENABLE; SETDESKTOPWARPING DISABLE;
Response	OK:ENABLED; ERR:ENABLED; OK:DISABLED; ERR:DISABLED; ERR:INVALID PARAMETER;

11.4 GETWINDOWWARPING

Description	Get the status of the window warping
Command	GETWINDOWWARPING;
Response	OK:ENABLED; OK:DISABLED;

11.5 SETWINDOWWARPING

Description	Enables of disables the window warping
Command	SETWINDOWWARPING ENABLE; SETWINDOWWARPING DISABLE;
Response	OK:ENABLED; ERR:ENABLED; OK:DISABLED; ERR:DISABLED; ERR:INVALID PARAMETER;

11.6 LOADPROCALIB

Description	Loads a .procalib file in the display for the currently selected config set
Command	LOADPROCALIB "\\.DISPLAY1" "C:\config\test.procalib";
Response	OK:LOADED; ERR:LOAD FAILED; ERR:INVALID FILE; ERR:INVALID PARAMETER;

11.7 SETCONFIGSET

Description	Selects one of the 8 available config sets. Set number can be 1 till 8.
Command	SETCONFIGSET 2;
Response	OK:2; ERR:INVALID PARAMETER;

11.8 SHOW

Description	Shows the GUI of the warping software.
Command	SHOW;
Response	OK:SHOW;

11.9 HIDE

Description	Hides the GUI of the warping software.
Command	HIDE;
Response	OK:HIDE;

11.10 QUIT

Description	Quits and closes the warping software.
Command	QUIT;
Response	OK:QUIT;

12 OSC interface

Open Sound Control (OSC) is a data transport specification (an encoding) for real-time message communication among applications and/or hardware.
OSC's address space is entirely user-defined, thereby allowing it to be both lightweight and endlessly customizable and extensible to the user's specific needs. OSC messages are differentiated from one another by a URI-style symbolic naming scheme allowing for hierarchical organization of the address space.
https://opensoundcontrol.stanford.edu/

Immersive Display PRO supports remote control of the most important functions using well defined set of OSC message. The OSC support can be enabled and configured in the Settings/Remote screen. Note: An Ultimate license is required to enable the OSC support.

The following is a set off supported OSC messages. The type letter before the parameters indicates the expected parameter type Supported types are s (string), i (integer) and f (float).

/control/show	Shows the GUI of the warping software.
/control/hide	Hides the GUI of the warping software.
/control/quit	Quits and closes the warping software.
/control/setdesktopwarping i:value	Enables of disables the desktop warping. Set value to 1 for enable. Set value 0 for disable.
/control/setwindowwarping i:value	Enables of disables the window warping. Set value to 1 for enable. Set value 0 for disable.
/control/setconfigset i:configset	Selects one of the 8 available config sets. configset number can be 1 till 8.
/control/loadprocalib s:display s:file	Loads a *.procalib file in the display for the currently selected

	config set. The display is the name of the display (e.g.: "\\.DISPLAY1) and the file is the full path of the procalib file to be loaded (e.g.: C:\config\test.procalib)