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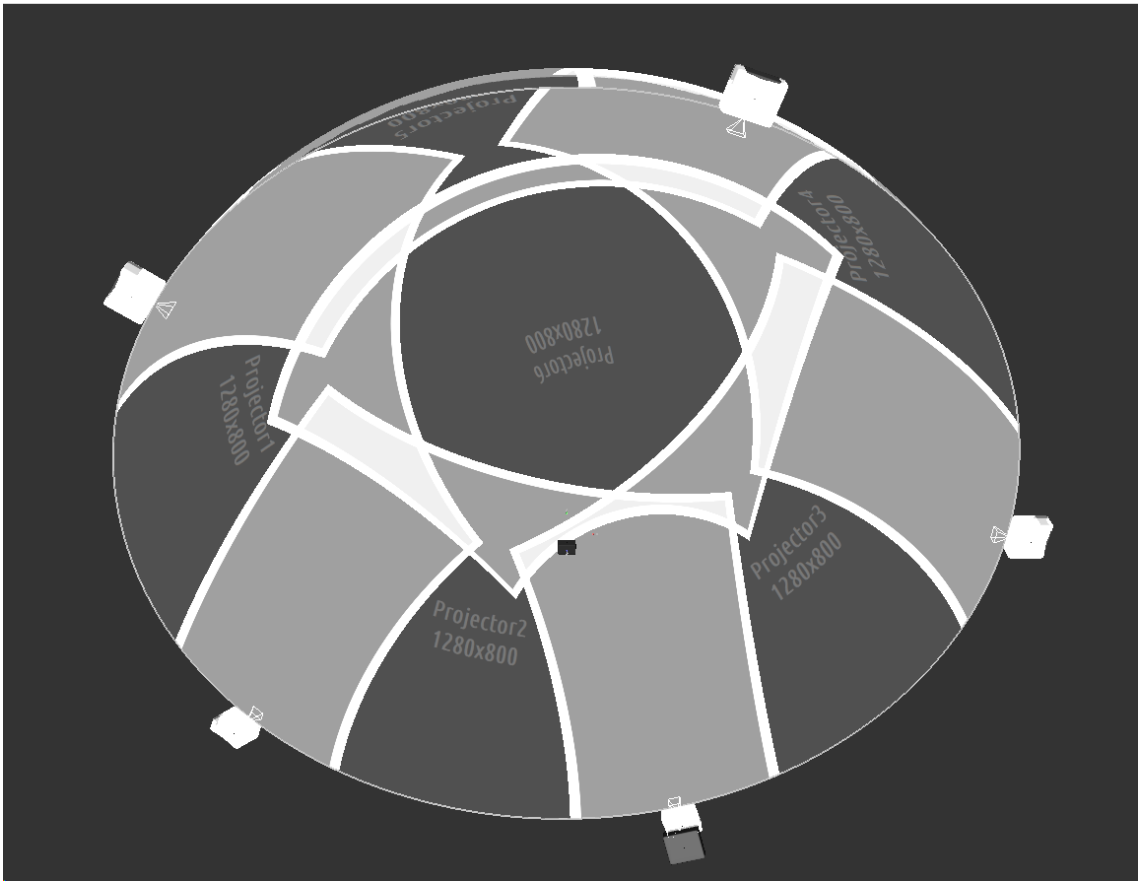
Fly Elise-ng
Immersive Calibration PRO
Step-By-Step Guide
Dome projection calibration

1 Introduction

This is a step-by-step guide for setting-up a seamless immersive projection using with a dome projection screen and multiple overlapping projectors.
The calibration produces a perfectly aligned and geometrically correct image by taking into account the projector positions and the screen shape.
At the end of the calibration, Immersive Calibration PRO exports several files including the virtual camera frustum settings (position, orientation and field of view), which can be used directly in the game or other 3D engine to produce the images for each projector.
Immersive Calibration PRO also exports a configuration file that can be used together with the Immersive Player PRO to be able to cut, warp and play dome master video content from a single PC on the calibrated screen.
Immersive Calibration PRO also exports the warping and blending configuration to be loaded and used in Immersive Display PRO for warping and blending the projected image to get a seamless display.

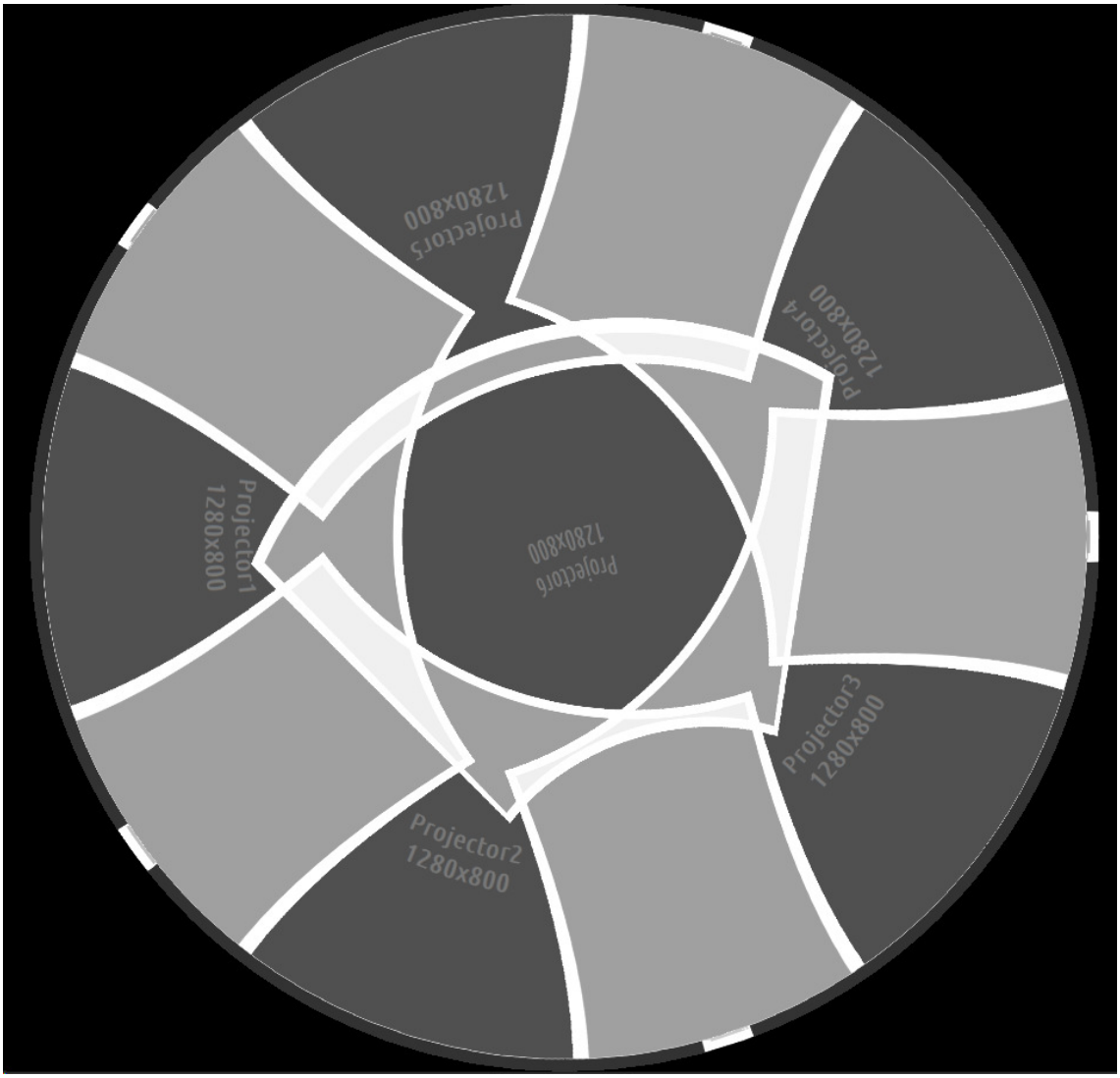
For this calibration a camera is needed that can capture the complete projection screen. For a 180 degrees dome projection screen the camera has to be equipped with a fisheye lens and has to be positioned near the center of the dome.
The calibration process involves mapping and aligning of the projection screen in the camera image and automatic mapping of the projectors on the screen. The automatic mapping is fully supported by the camera. The needed steps for the calibration will be explained further in this step-by-step- guide.

For the purpose of this dome calibration step-by-step guide we will use a 3 meters dome projection screen with 6 projectors connected to a single PC. The resolution of the projectors is 1280x800 and they are connected to an AMD Radeon™ R9 Series Graphics. The 6 projectors are positioned in such a way that the complete projection screen is covered by a projection images from projectors and that the projector images overlap.

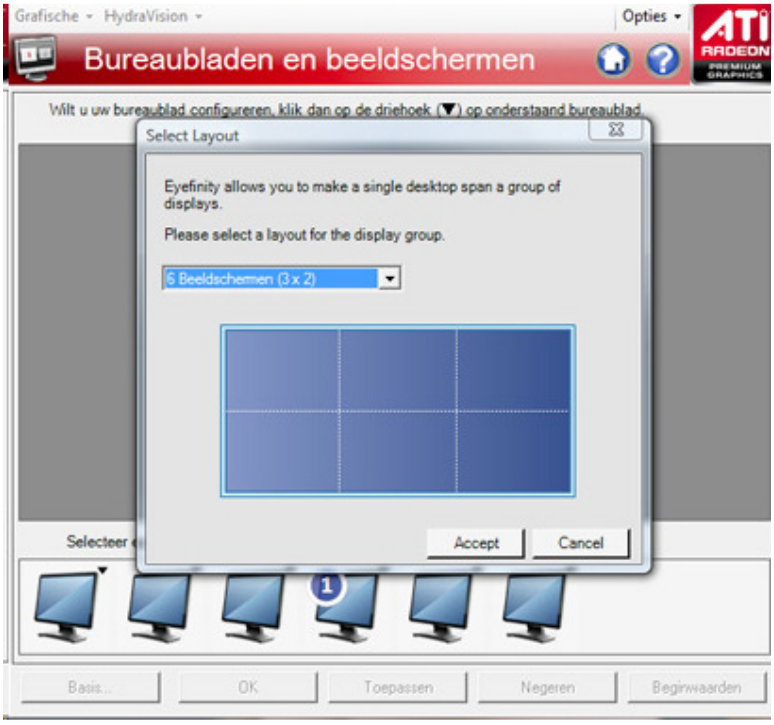


A Canon EOS 1200D camera with Sigma 4.5mm Fisheye Lens is used. The software supports all Canon EOS and Rebel (TXi) cameras.
The camera is positioned near the middle of the projection dome and oriented upwards towards the zenith of the dome.

When positioned in such a way, the camera image will contain the complete dome projection surface and all projector images on the dome.



We will use two computers to perform the calibration:
One PC has 6 outputs connected to the 6 projectors. The simplest configuration is to configure one wide display group in either 6x1 or 3x2 group. For this tutorial we are going to use 3x2 group. The graphical engine program (ex Prepar3D, X-Plane, Unity, Unigine, etc.) and the video playback software will run on this display.



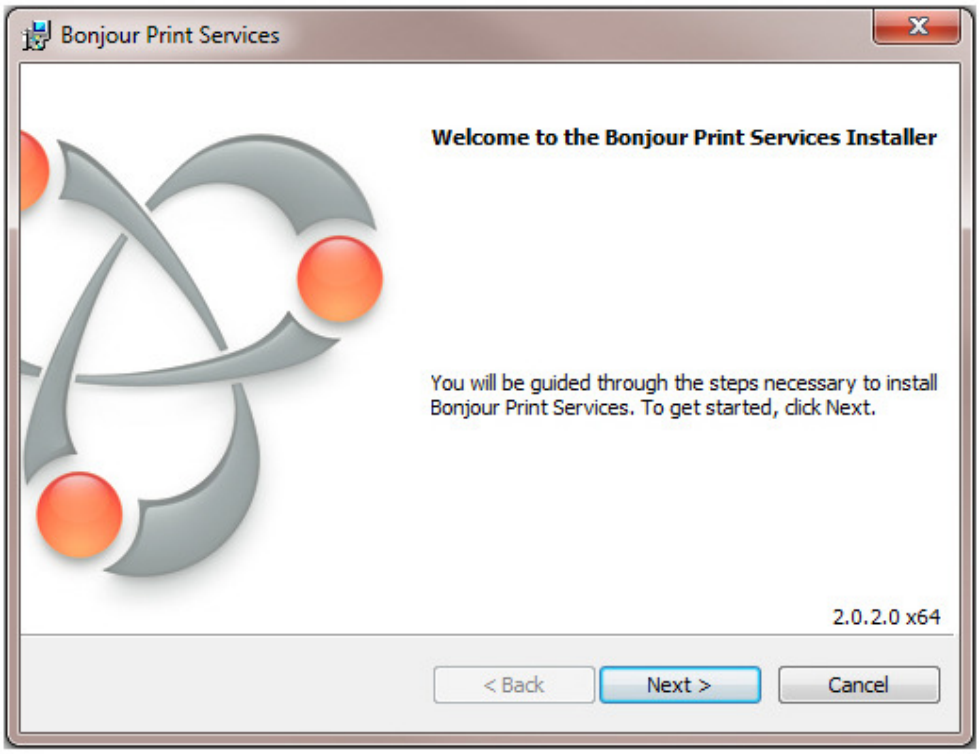
The name of this PC is **WIN7** and will be used as **Rendering Client** during the calibration.

The second PC will be used as **Controller Server**. It can be any PC with a moderate graphical card with at least one monitor connected. This PC has to be connected in a network with the Rendering Client WIN7 PC. The Name of the Controller Server PC is **SERVER**.

The **SERVER** PC is needed only during the calibration and can be removed after the calibration is completed and calibration results are saved.

2 First time Bonjour installation

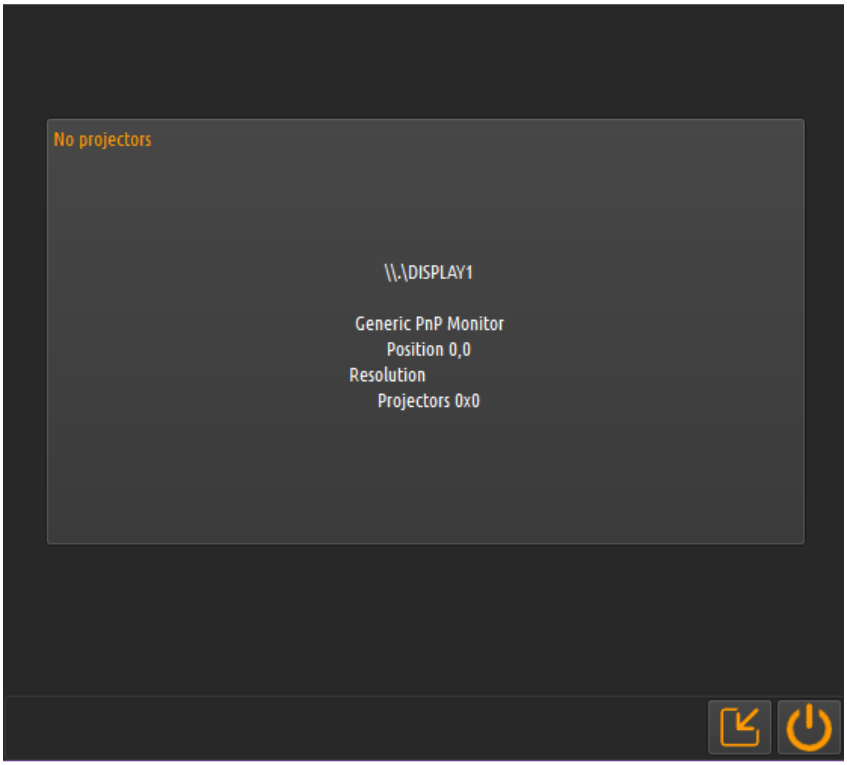
In order to automatically recognize and connect the client and the server PC on the network, a zero-configuration service is used. For this purpose the Bonjour service needs to be installed on both the client and the server PC.
From the Immersive Calibration PRO locate and double click on the INSTALL_FIRST_BONJOUR.bat script. This will start the installation of Bonjour. This installation step is needed only once and should be performed the first time Immersive Calibration PRO is used on the PC.
Follow the installation steps of Bonjour install script and finish the installation.



Note: If using firewall, make sure that the firewall is disabled on both the client and the server PC in order to allow the client and the server PC to connect to each other without being blocked by the firewall.

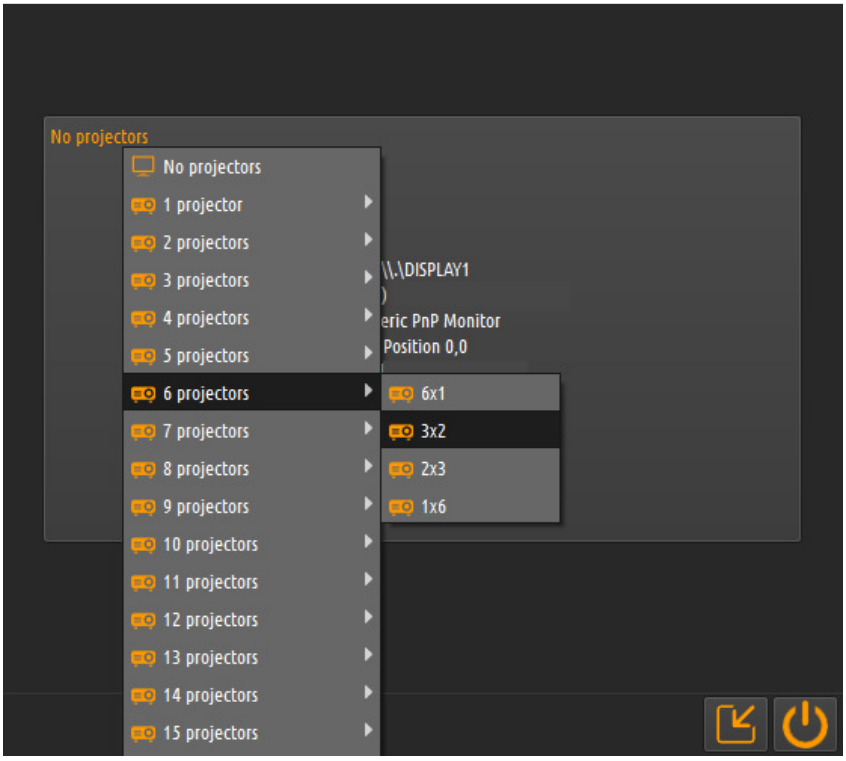
3 Start and configure the Rendering Client

On the rendering client PC, start the Client.exe program from Immersive Calibration PRO installation folder. Immersive Calibration PRO will start in client mode and will show the available displays.



Right-click on the display that is connected to the projectors and select projector configuration 3x2 from the popup menu.

The selected display will be configured with projector configuration 3x2 and the rendering client will be prepared to be connected to the server.
A tray icon will be shown on the system tray to indicate that the client is running.

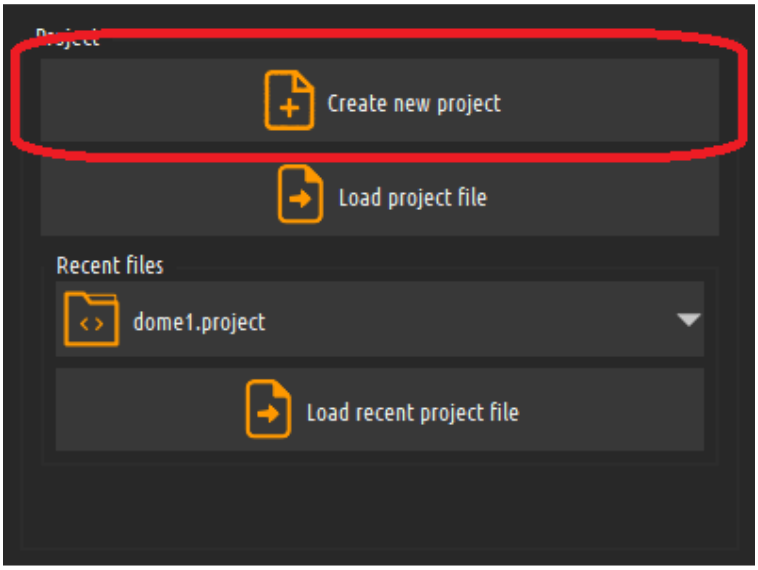


Press the “Hide” button to minimize the client window. When the server is connected to the client, the client window will be opened in full screen mode on the 3x2 display.

Note: The projector configuration will be automatically saved. The next time Client is started, it will automatically use the saved projector configuration.

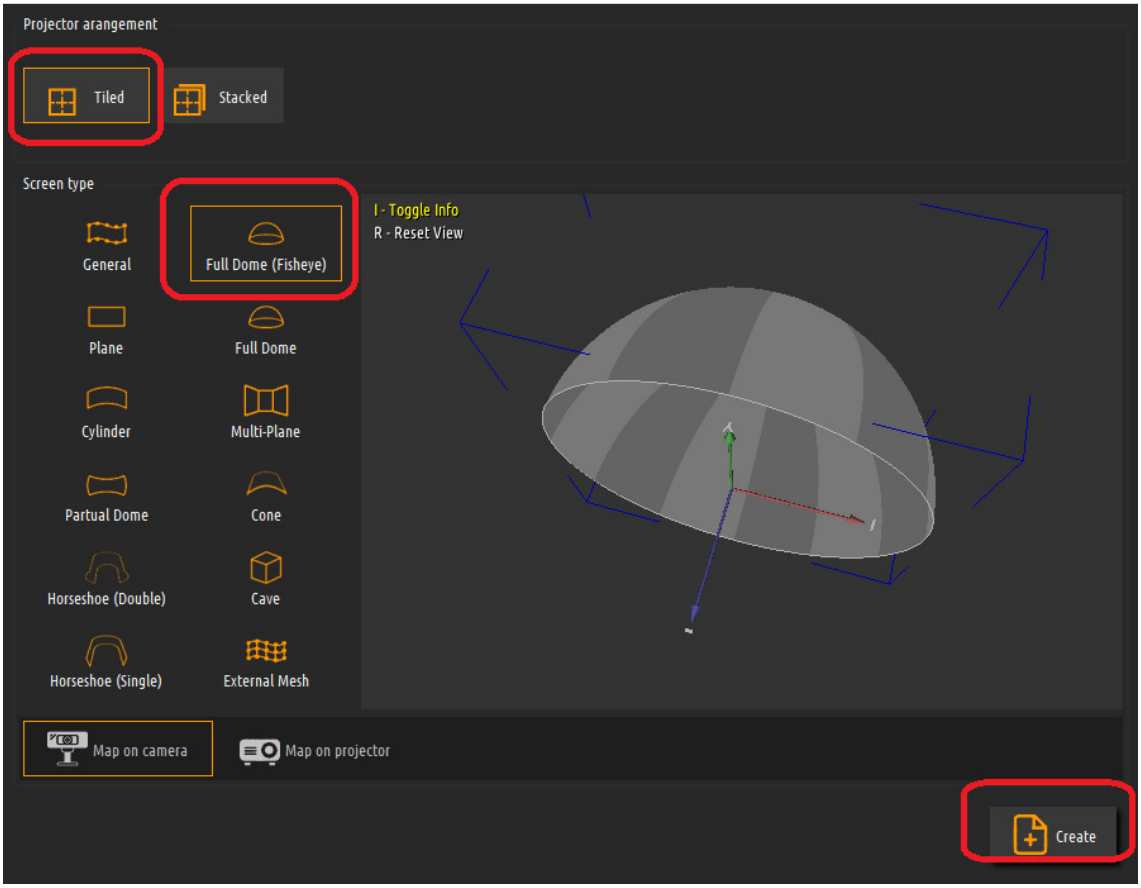
4 Start and configure the Controlling Server

On the controlling server PC, start the Server.exe program from Immersive Calibration PRO installation folder. Immersive Calibration PRO will start in server mode.



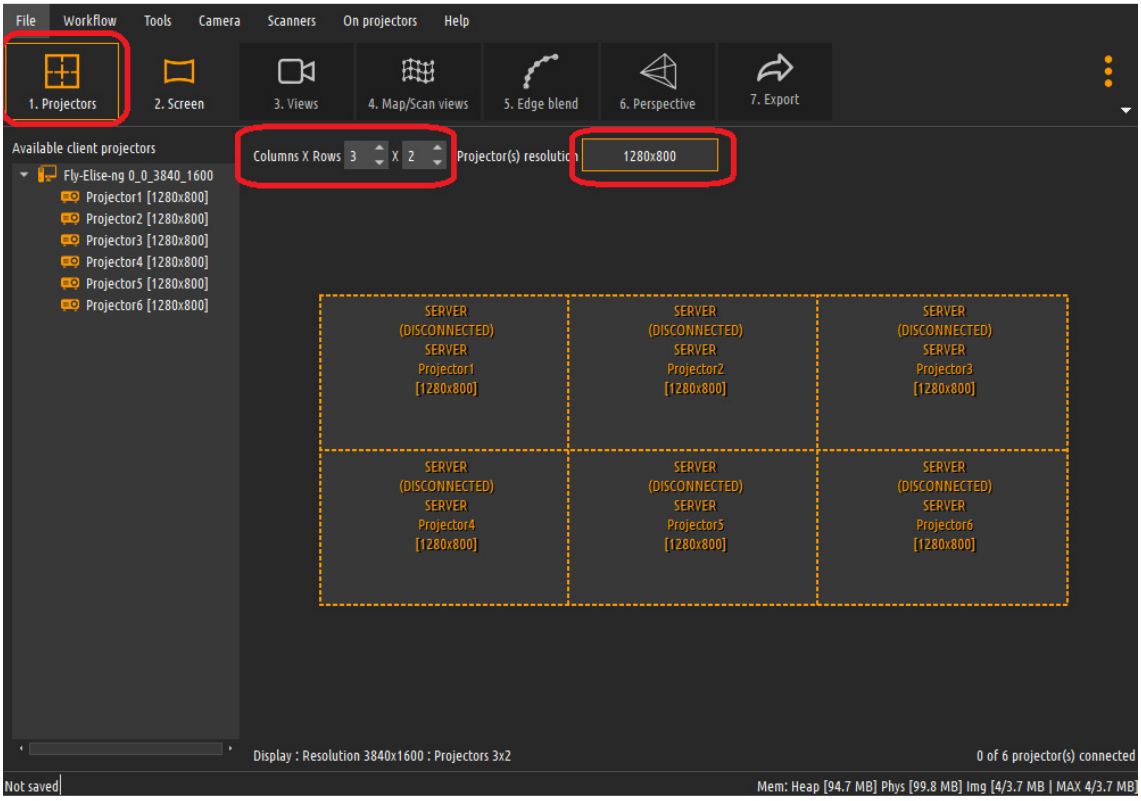
When starting for the first time, select “Create new project”. Once the project is saved, the project can be loaded by selecting “Load project file.

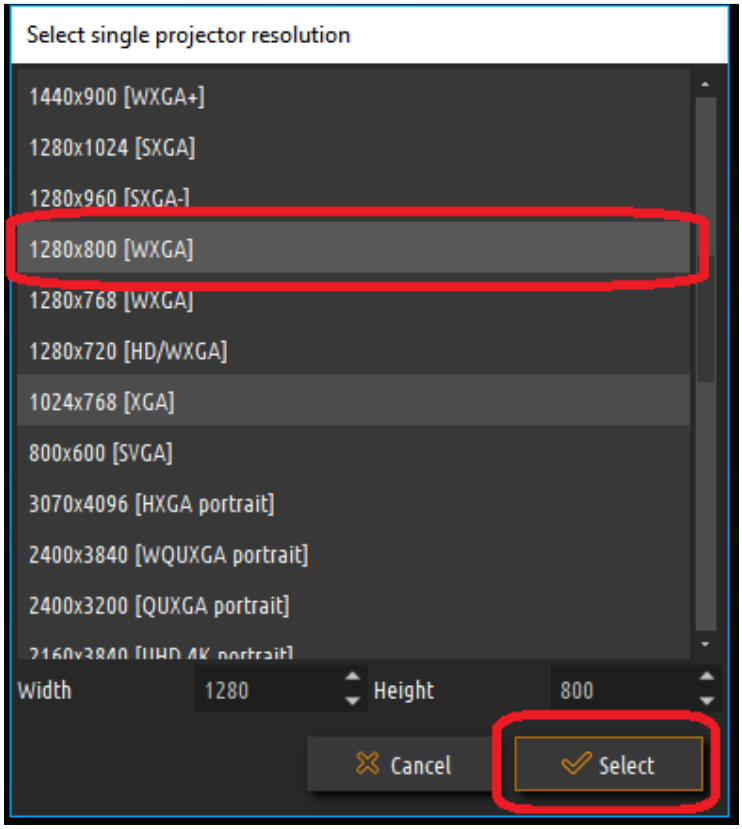
From the screen type selection list, select “Full dome (dome master)” projection screen. The “Map to camera” will be automatically checked. Click on “Create”



The Controller Server window will be started that shows the “Virtual Display”.

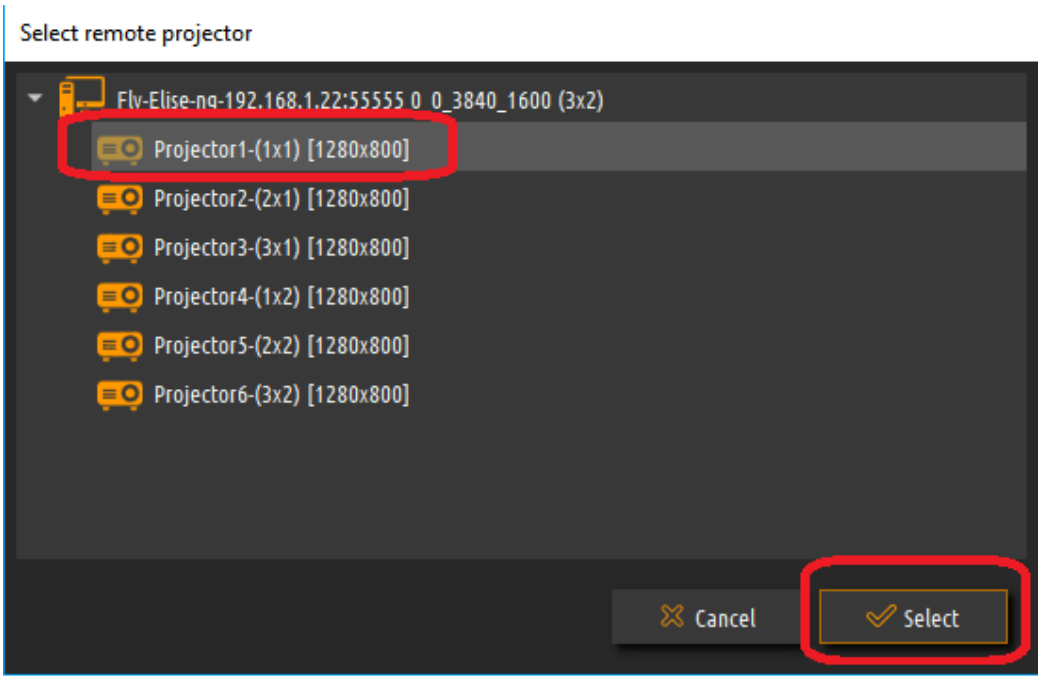
The virtual display is initially not configured. Set the projector configuration 3x2 and set the individual projector resolution to 1280 x 800.


File
Workflow
Tools
Camera
Scanners
On projectors
Help
1. Projectors
2. Screen
3. Views
4. Map/Scan views
5. Edge blend
6. Perspective
7. Export
Available client projectors
Fly-Elise-ng 0_0_3840_1600
Projector1 [1280x800]
Projector2 [1280x800]
Projector3 [1280x800]
Projector4 [1280x800]
Projector5 [1280x800]
Projector6 [1280x800]
Columns X Rows 3 X 2
Projector(s) resolution
1280x800
SERVER (DISCONNECTED) SERVER Projector1 [1280x800]
SERVER (DISCONNECTED) SERVER Projector2 [1280x800]
SERVER (DISCONNECTED) SERVER Projector3 [1280x800]
SERVER (DISCONNECTED) SERVER Projector4 [1280x800]
SERVER (DISCONNECTED) SERVER Projector5 [1280x800]
SERVER (DISCONNECTED) SERVER Projector6 [1280x800]
Display : Resolution 3840x1600 : Projectors 3x2
0 of 6 projector(s) connected
Not saved
Mem: Heap [94.7 MB] Phys [99.8 MB] Img [4/3.7 MB | MAX 4/3.7 MB]


Select single projector resolution
1440x900 [WXGA+]
1280x1024 [SXGA]
1280x960 [SXGA-]
1280x800 [WXGA]
1280x768 [WXGA]
1280x720 [HD/WXGA]
1024x768 [XGA]
800x600 [SVGA]
3070x4096 [HXGA portrait]
2400x3840 [WQUXGA portrait]
2400x3200 [QUXGA portrait]
2160x3840 [UHD 4K portrait]
Width
1280
Height
800
Cancel
Select

The virtual display will be configured with projector configuration 3x2. The individual projectors are not “assigned” and not connected yet to the projectors defined in the “Rendering Client”.

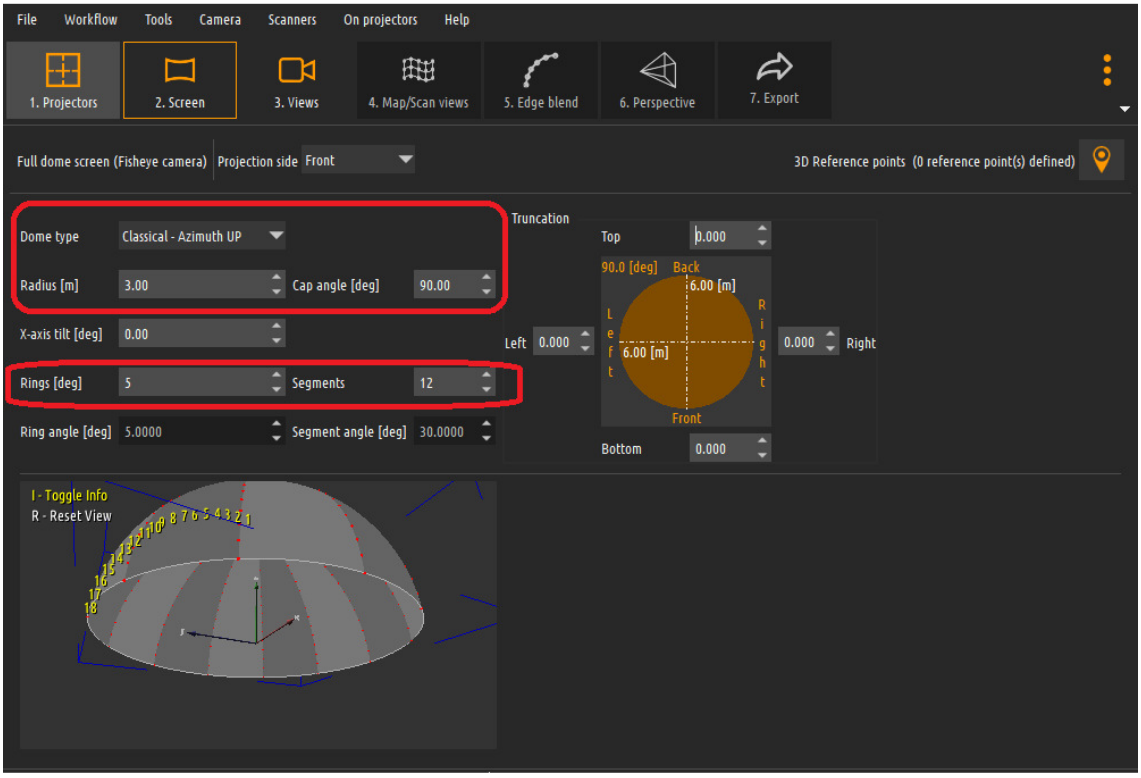
Double click on each projector to connect to a projector defined in the “Rendering Client”. If the “Rendering Client” successfully connected to the “Controller Server”, a list of the projectors will be presented. Select a projector from the right list to “assign” the projector. This will assign and connect the virtual display projector to a remote projector.



Repeat this step for all projectors.
When all projectors are assigned click the “Screen” button to define the dome projection screen.

5 Configure the projection screen

In the screen configuration enter the screen dimensions.
If the projection screen has visible slices and rings (due to the construction of the screen) enter the correct number of slices and rings. The slice lines go from the zenith of the dome to the edges of the dome.

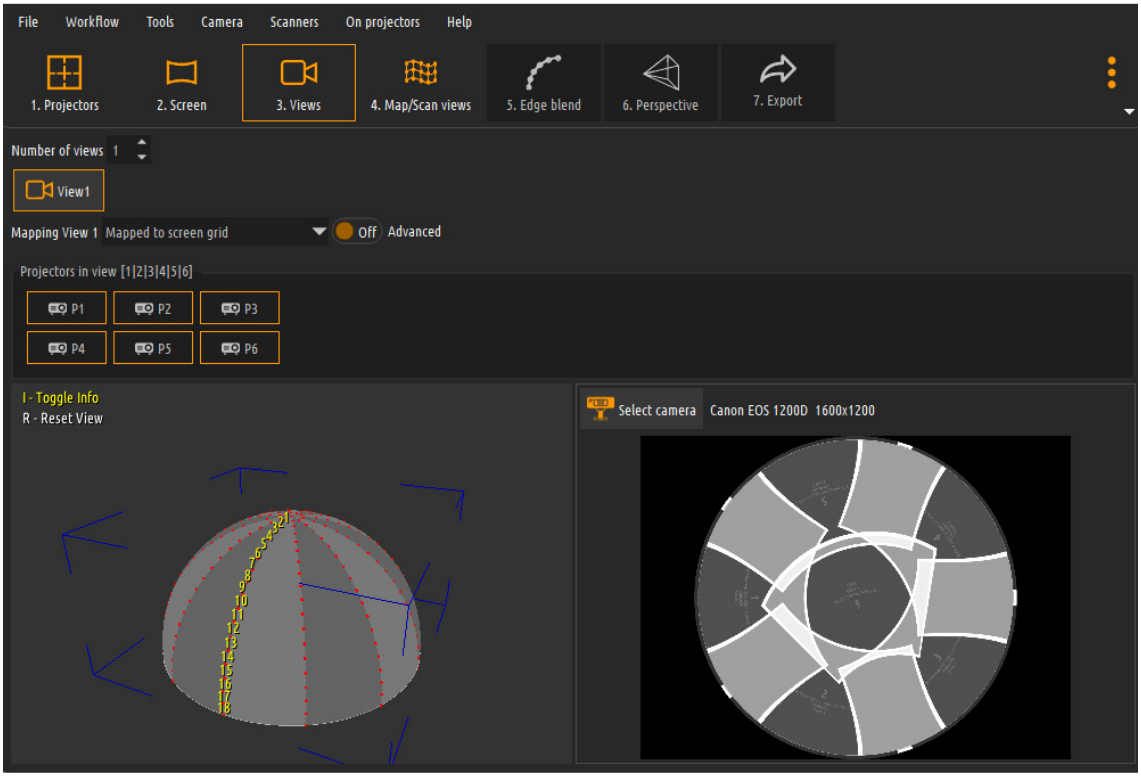


For the hanging dome make sure that “Azimuth UP” is selected. This will make sure that the calibration pattern will use “Front/Back” notation.

6 Configure the views

The Views tab is automatically configured for 1 view (camera) and all 6 projectors are mapped in the same view. Press “Select camera” and select the Cannon camera. Note, the Cannon camera must be enabled in the Tools/Plugins configuration

No extra configuration is needed in the Views tab.

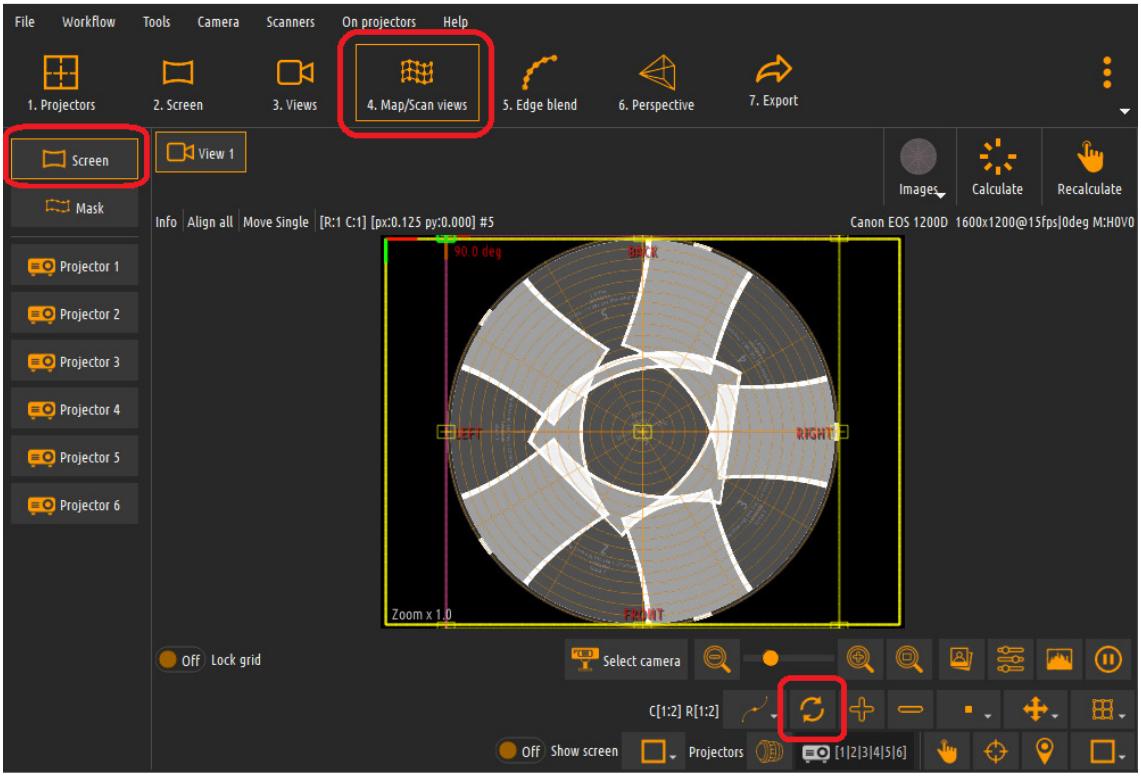


This finishes the configuration of the calibration settings. The next steps will describe the mapping of the screen and the projectors.

Use the File/Save menu to save the calibration settings.

7 Map/Scan the view

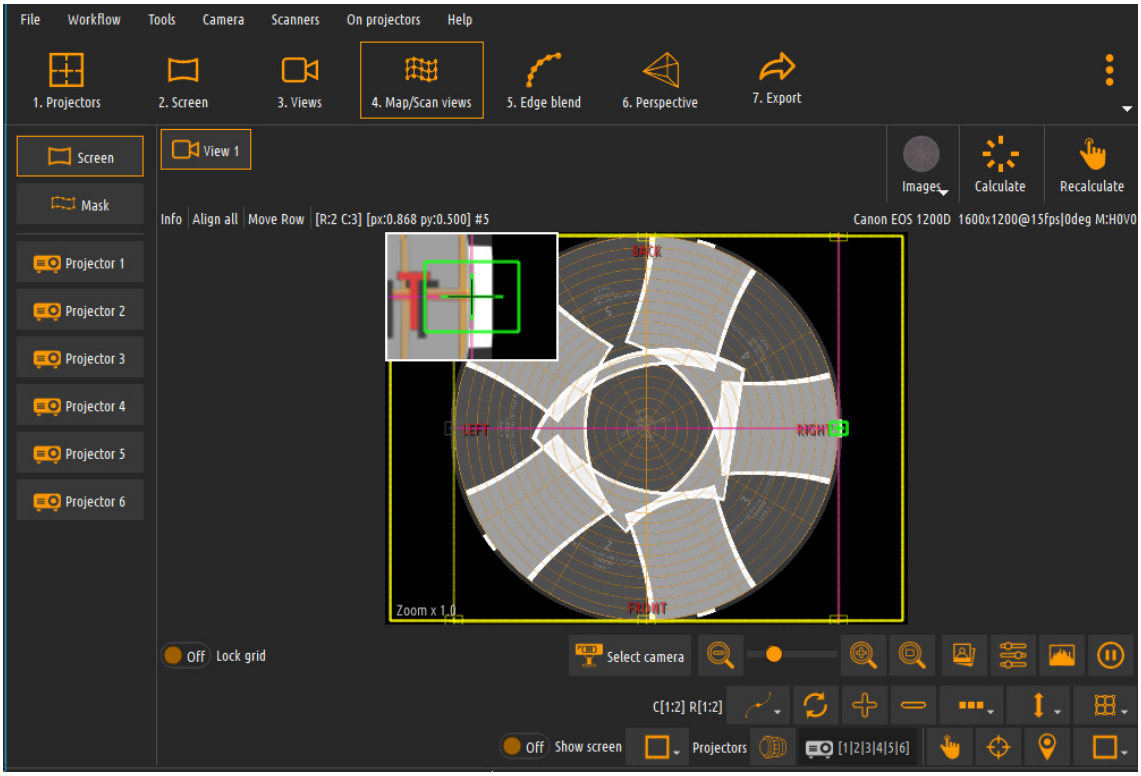
The next step in dome screen calibration is to map the screen grid to fit and match the screen in the camera view. Press the Map/Scan views button.



This will show the screen grid on top of the camera image. The camera image will show the complete dome projection screen. Press the reset “Reset grid” button to center the screen grid to match the dome circle. When needed use the grid control points to align the grid with the edges of the dome circle and the dome center (zenith).

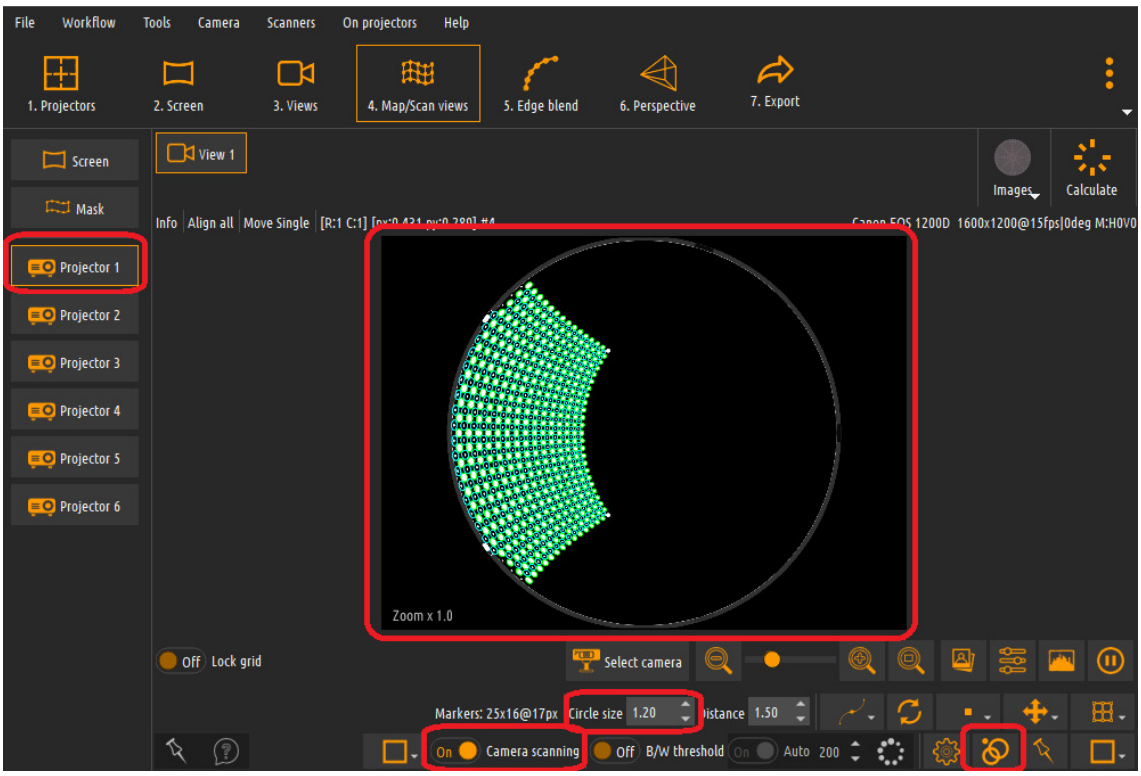
For more accurate mapping press the keyboard “Z” key to show the “Zoom” view, and use the “Move Mode” and “Move Constraint Mode” buttons selection to automatically move the whole grid row of column and to constraint the movement horizontally or vertically.

Align the screen grid with the screen shape as good as possible. The grid slices and rings should follow and match the dome projection screen shape.



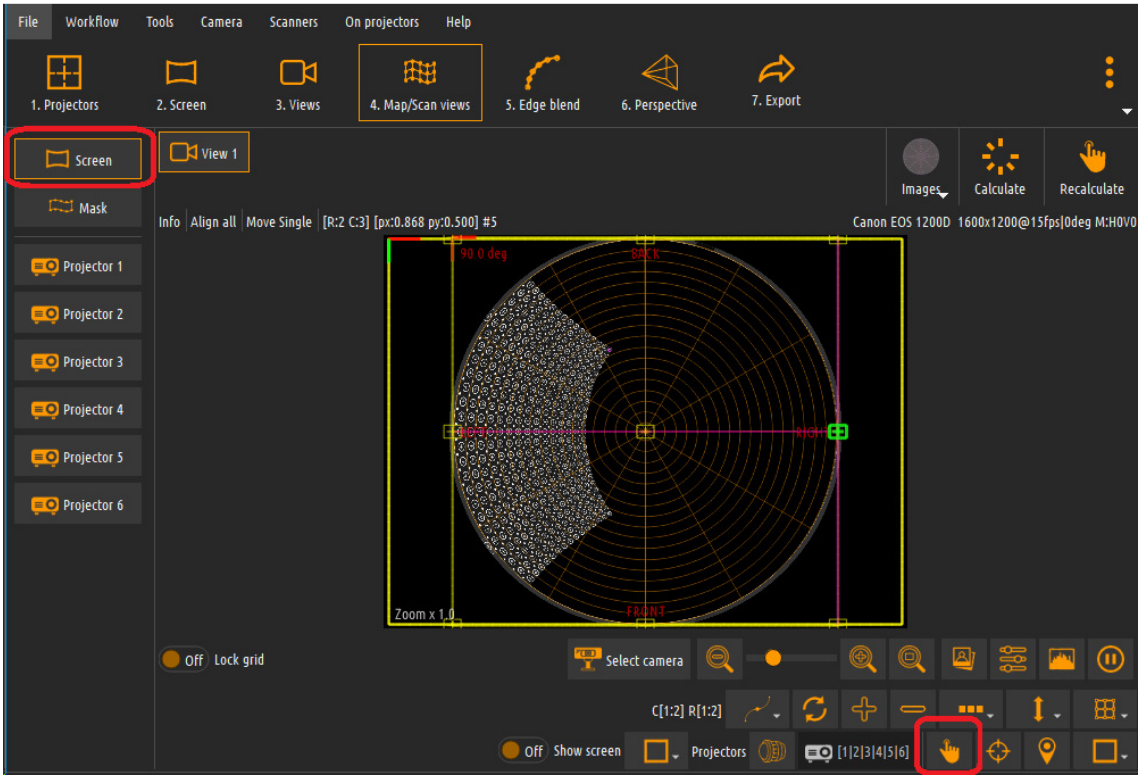
This concludes the screen grid mapping step. The next steps will describe the automatic projectors mapping. Automatic projectors mapping is a process to accurately map the projector images on the screen in order to automatically calculate the needed geometrical correction and soft-edge blending.
Camera images will be used to automatically map the projectors. This is the same for all projectors.

Select the first projector from the list of projectors in this view.
Make sure the “Camera scanning is enabled” and press on “Recognize projector circles” button.
Press the “Recognize projectors circles” button will quickly verify which circles can be successfully recognized and mapped. The recognized circles will be shown in green color. Not all circles need to be successfully recognized for a successful calibration. The not recognized circles will be automatically estimated by the software. If needed, adjust the camera settings and increate the circle size to be able to recognize as much circles as possible.

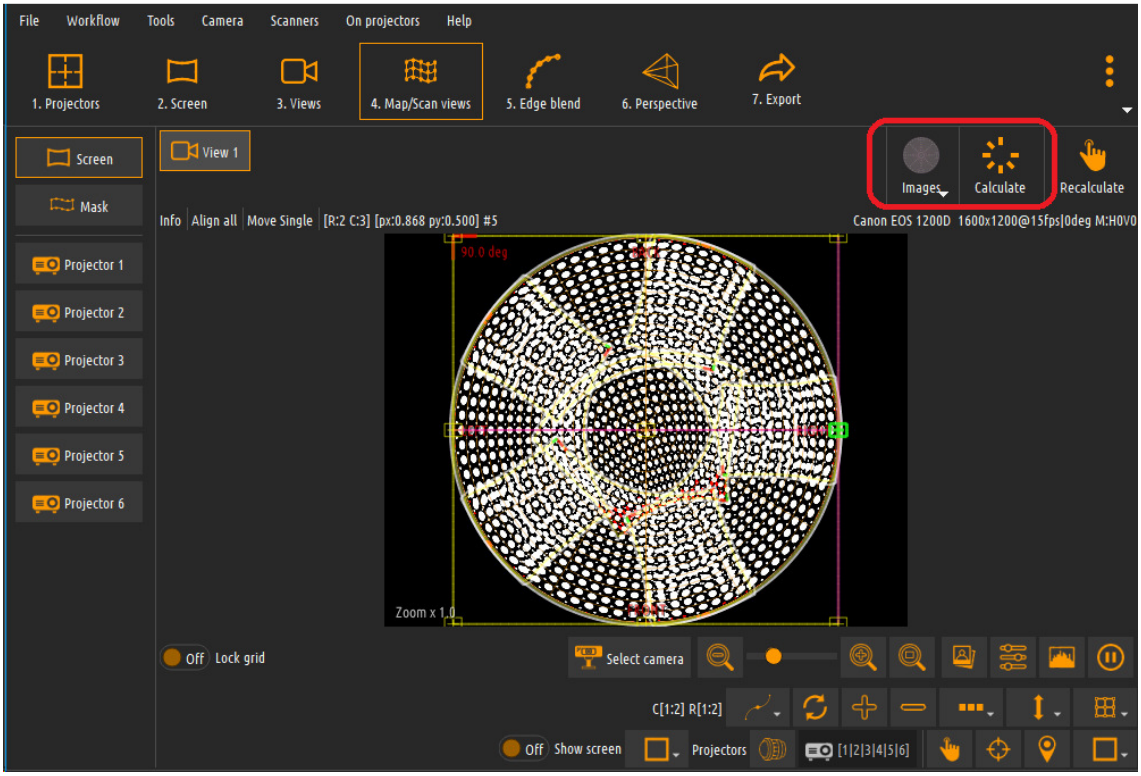


Repeat this for every projector to make sure that the projectors scanning will scan all projectors successfully.

After that, select the “Screen” button in the view and press the “Scan all projectors” button to scan all projectors on the screen.

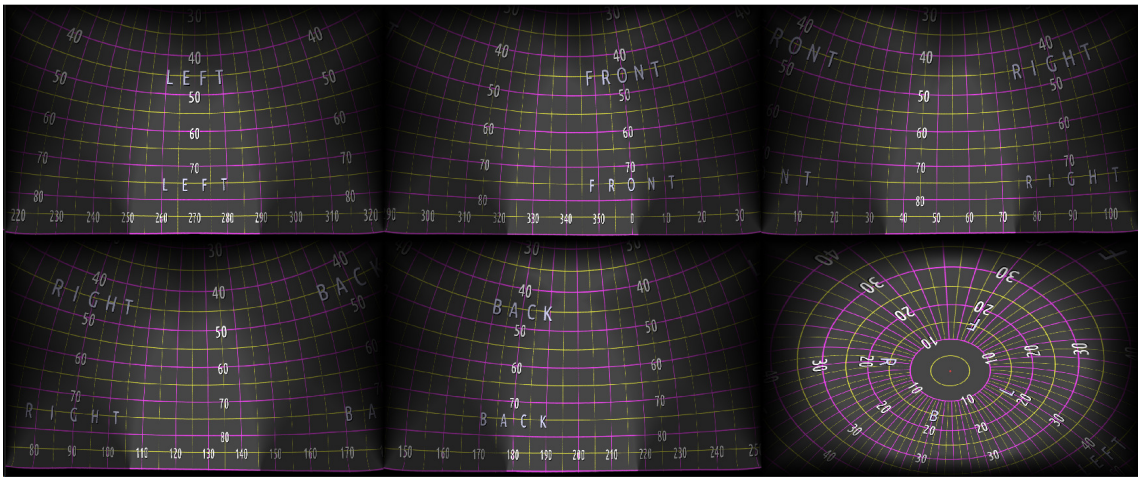


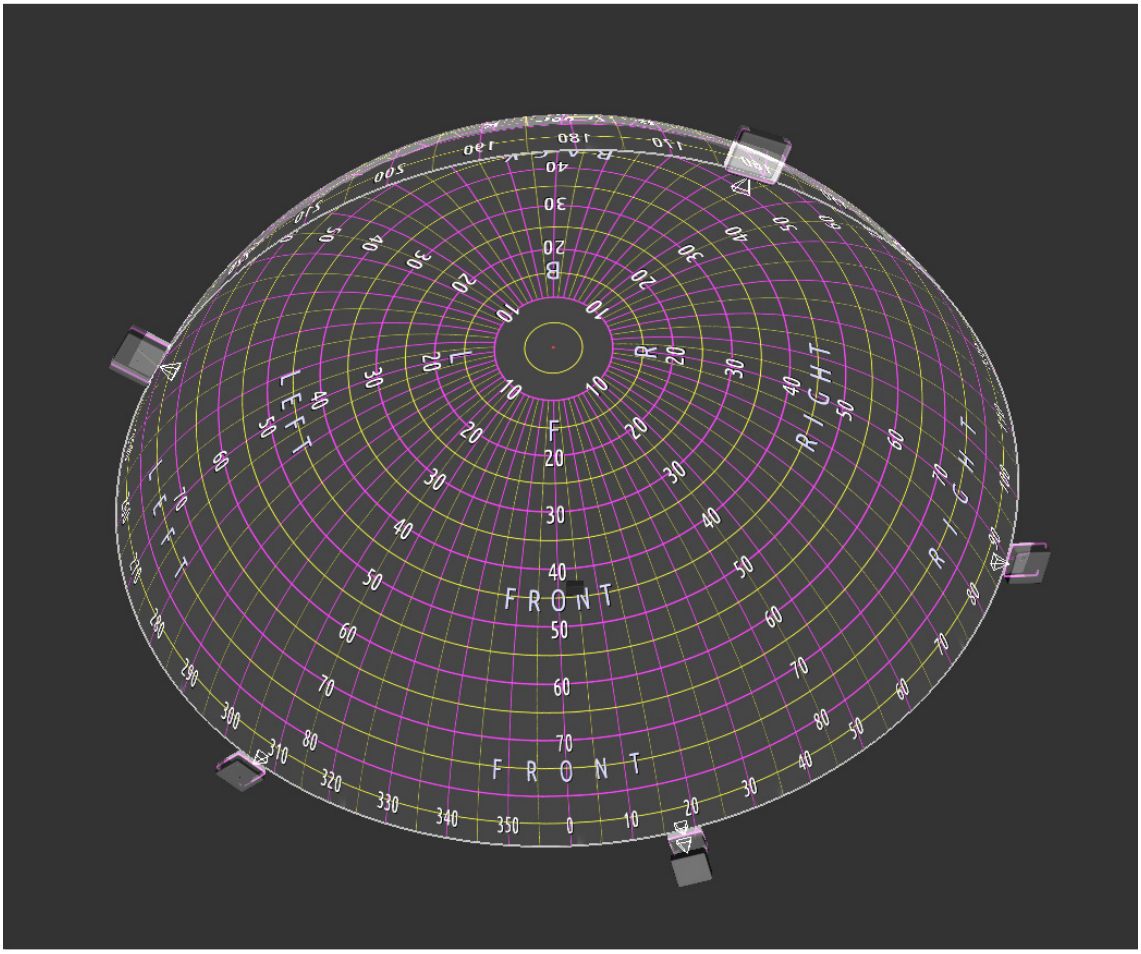
After the scanning finished, all the scanned circles will be shown in white. Press the calculate button to calculate the geometrical correction, auto-alignment and edge blending. Optionally, change the images to preview the alignment.



After the calculation finishes, change the images to preview the alignment. The test image contains text of the sides of the dome as well as horizontal and vertical angles.

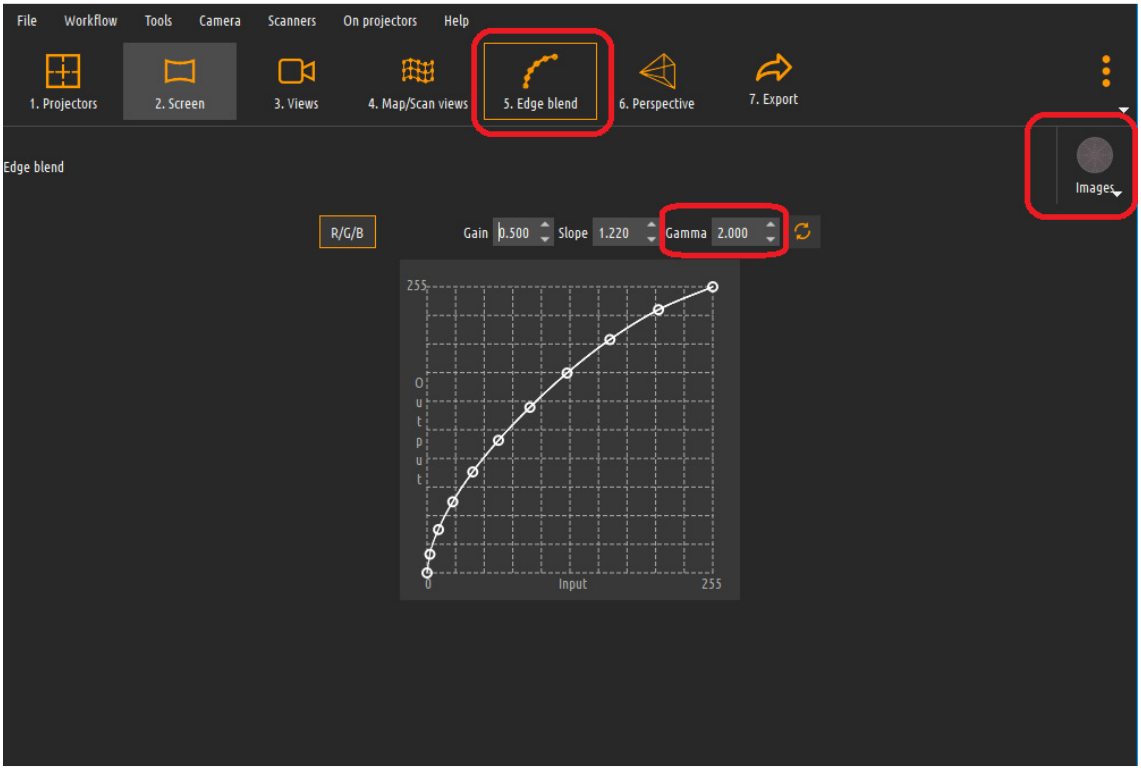
The projectors will project warped and blended images in such a way that when projected on the dome projection screen the results will be one continuous image.





8 Edge - blend

Click the edge-blend button to fine tune the edge blend if needed. The default setting give for most of the projectors the best results. If the projectors have different gamma profile, do a slight change to the gamma value to achieve the best edge blend. Use different images to verify the blending.

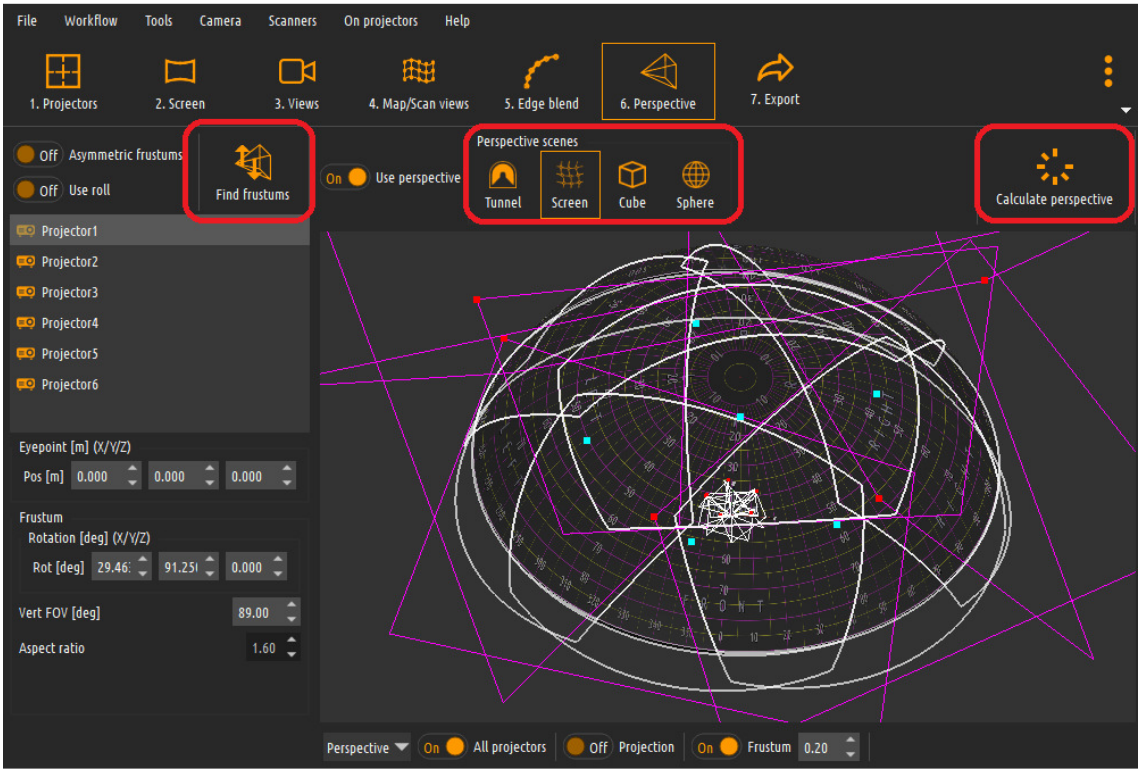


When the result is satisfactory Save the selected settings in a ".project" file using the File/Save menu.

9 Perspective projection

When projecting the content of a 3D application (Games, Simulators, CAD, etc.) that have support for multiple cameras, each projector can project image from a single virtual camera. The total projected image will not be constrained by a single camera field of view but it will match the projection screen field of view.

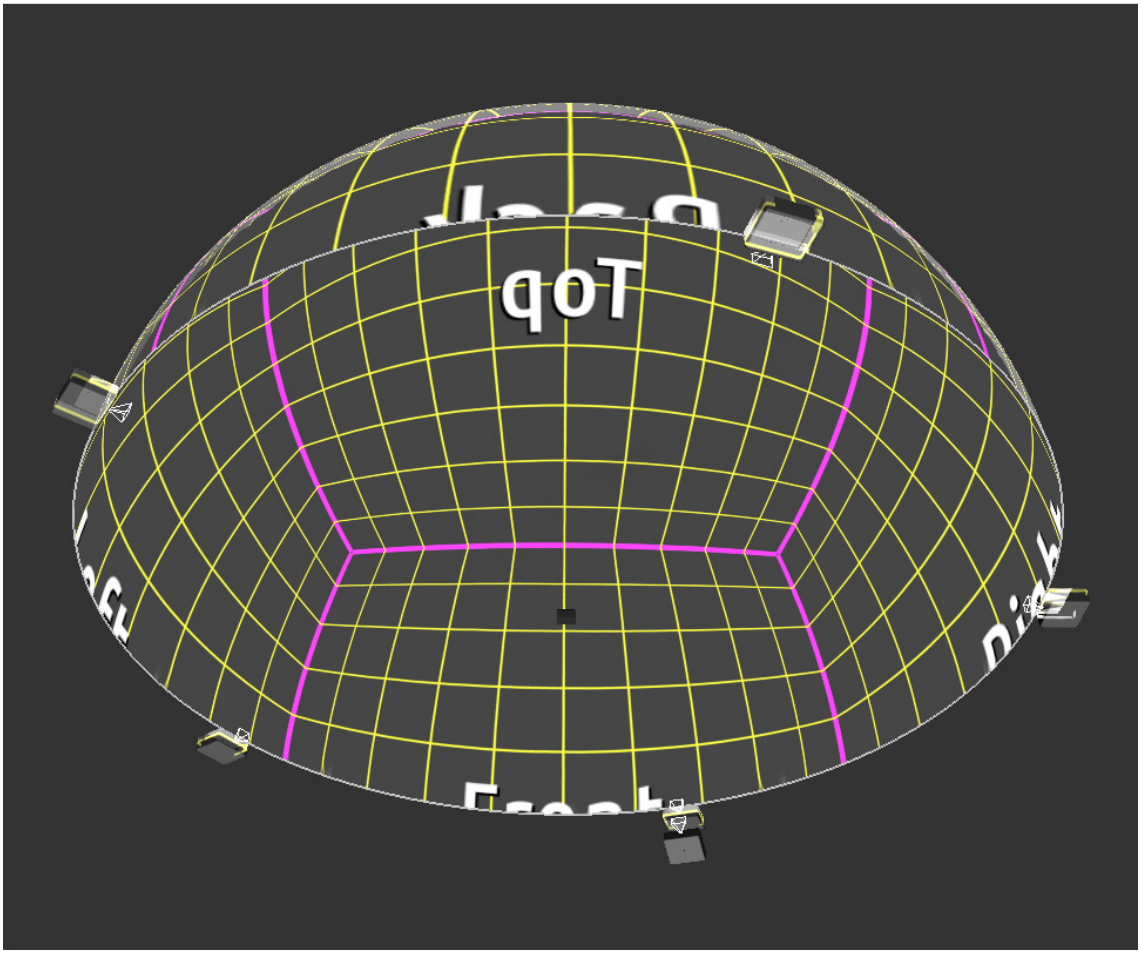
Before calculating the perspective mapping, make sure that the previous steps are performed successfully. Those steps will perform projectors mapping to screen mapping which is a basis for the perspective mapping.
Select the "Perspective" button to enter the perspective configuration screen.
First press the "Find frustums" button. This will find the perspective frustums for all projectors.



Then press “Calculate perspective” button. This will calculate the perspective correction and the edge blending for each projector.

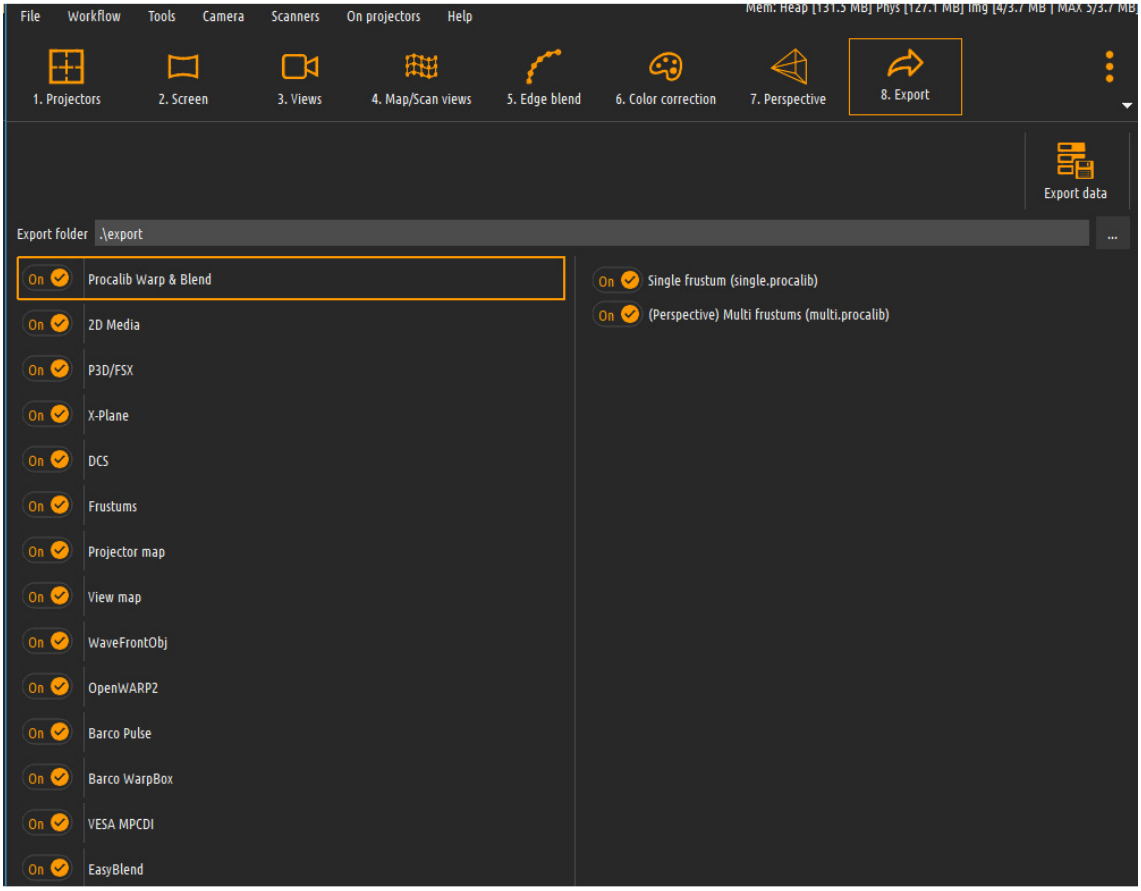
After calibration finished the results are send to the Rendering Client PC. A test 3D mesh scene or a tunnel scene that corresponds to the screen shape will be projected on the screen from multiple projectors.

Use the available perspective scenes to verify the calculation.



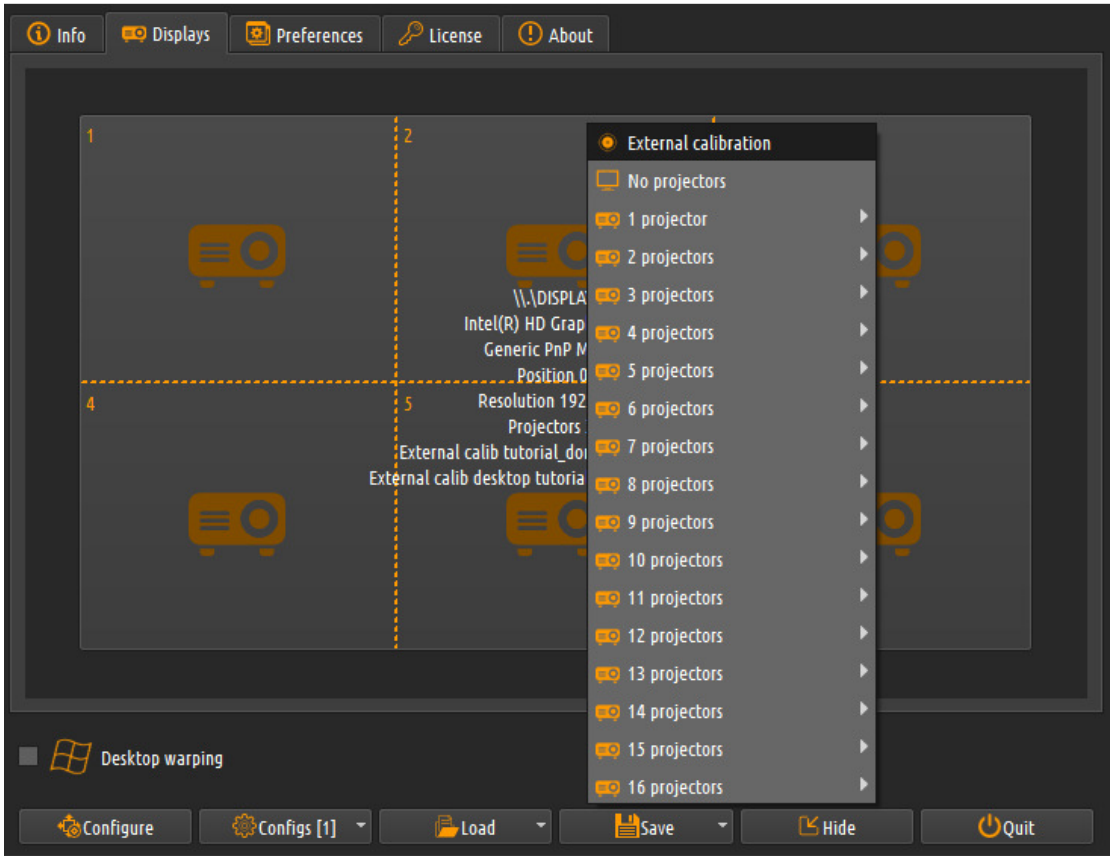
10 Export the calibration result

The calibration can be exported to a file that can be used inside Immersive Display PRO. Also a set of virtual camera parameters (frustums) will be exported that can be used directly or indirectly in to position and orient the cameras in the game or other 3D engine software.
Press the “Export” button to enter the export screen.



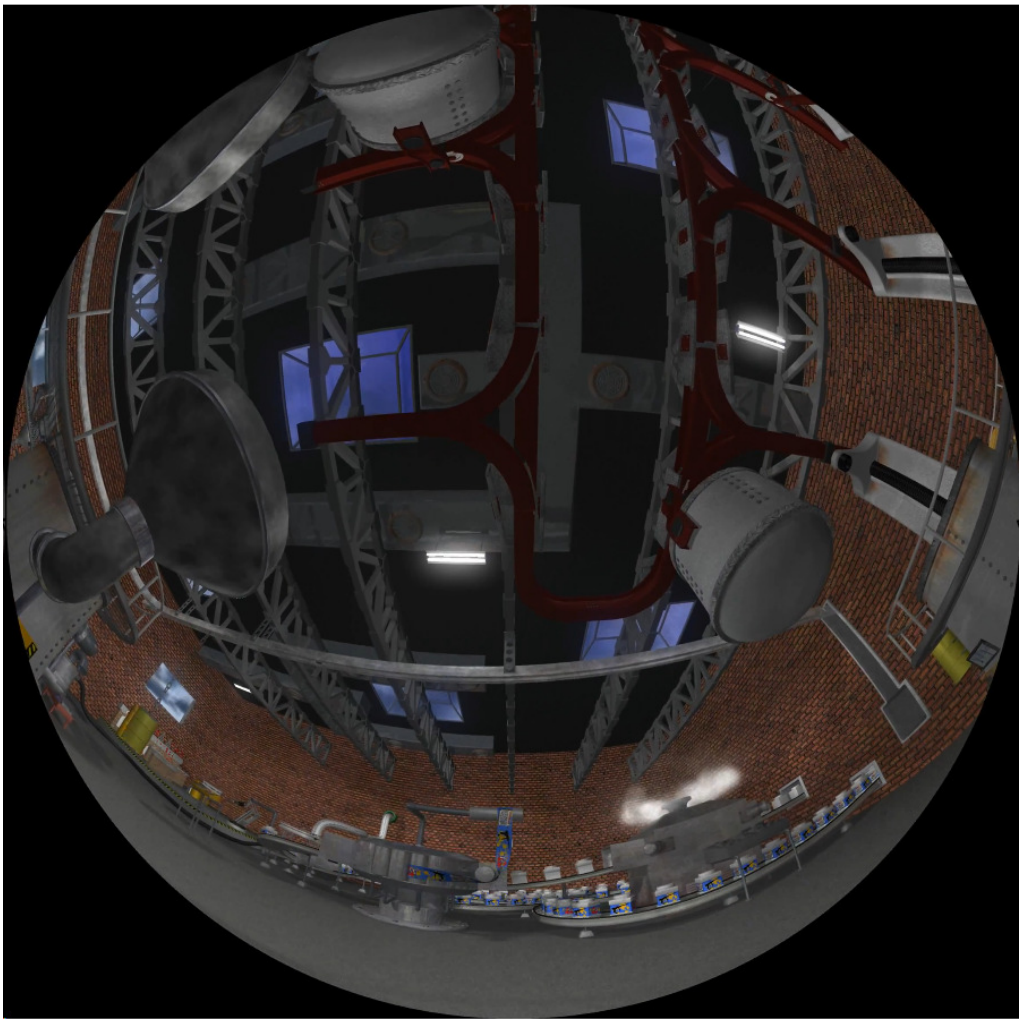
Select the needed additional exports and press the “Export data” button. Several .procalib files will be exported with the filename selected from the export dialog. The .procalib files can be imported in Immersive Display PRO.

The _single.procalib file should be used when projecting a single virtual camera content (video, desktop, etc.).
The _multi.procalib file should be used when projecting multiple virtual cameras content (games, simulators, 3d engines, etc.).

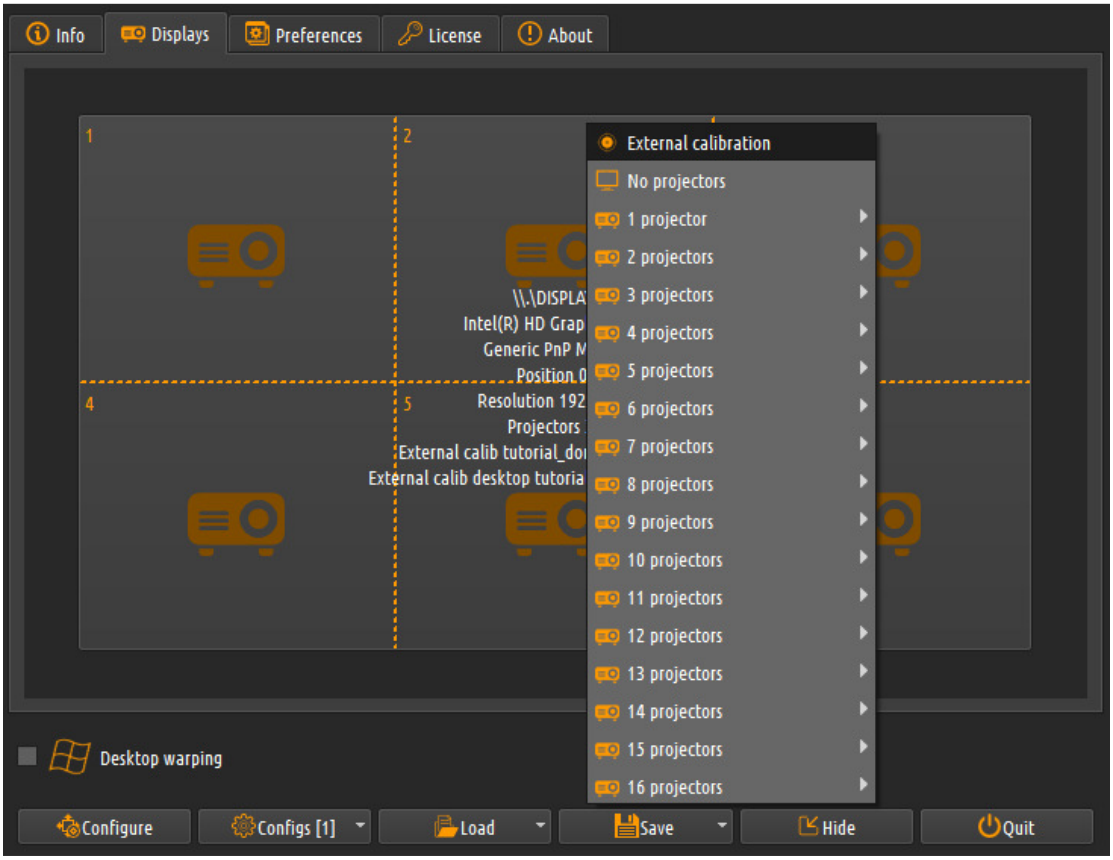

Info
Displays
Preferences
License
About
1
2
4
5
External calibration
No projectors
1 projector
2 projectors
3 projectors
4 projectors
5 projectors
6 projectors
7 projectors
8 projectors
9 projectors
10 projectors
11 projectors
12 projectors
13 projectors
14 projectors
15 projectors
16 projectors
Desktop warping
Configure
Configs [1]
Load
Save
Hide
Quit

11 Dome master video playback from a single PC

The exported *single.procalib can be used to playback a standard definition, high definition or ultra-high definition dome master video content. Dome master video contains 180 degree video usually taken by a fisheye camera. The video image size is square (width==height)

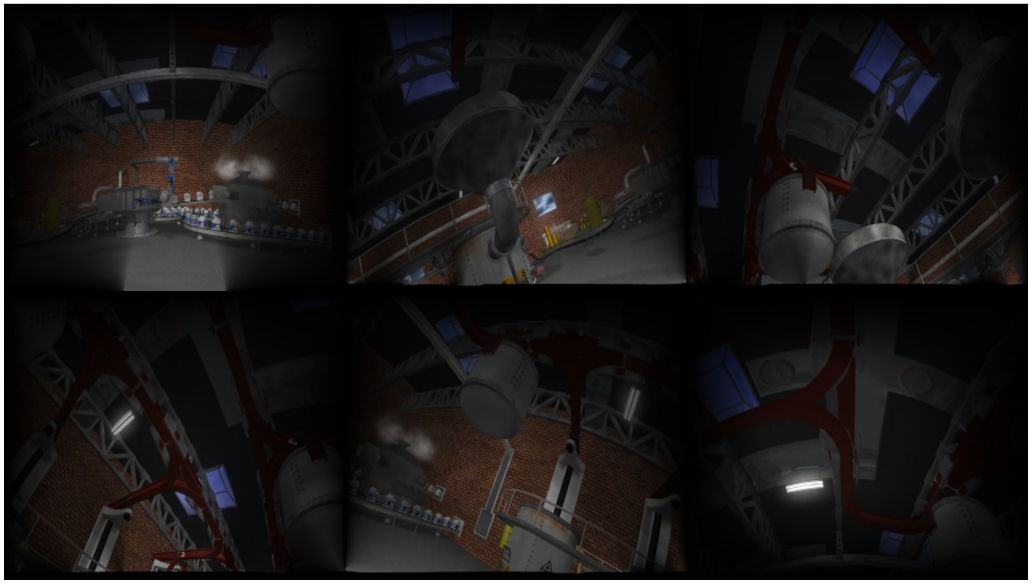


Start Immersive Display PRO, go to Display Tab and click on the display. From the drop down menu select “External calibration” and load the *_single.procalib file.

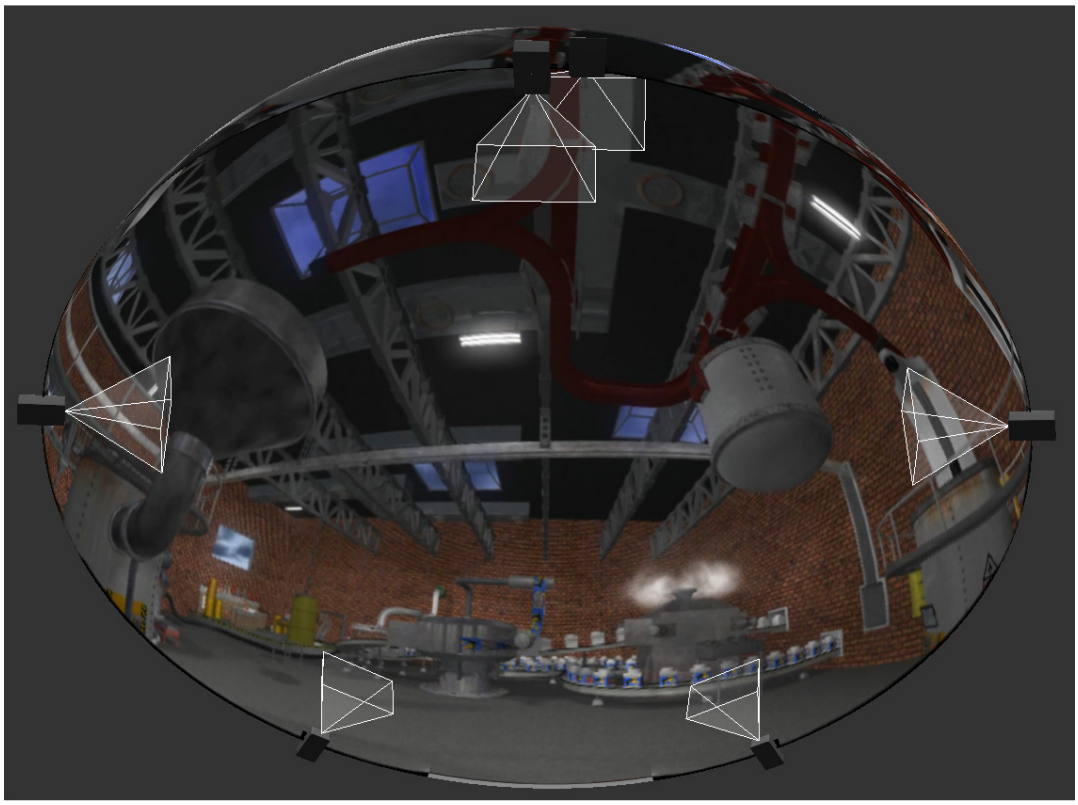


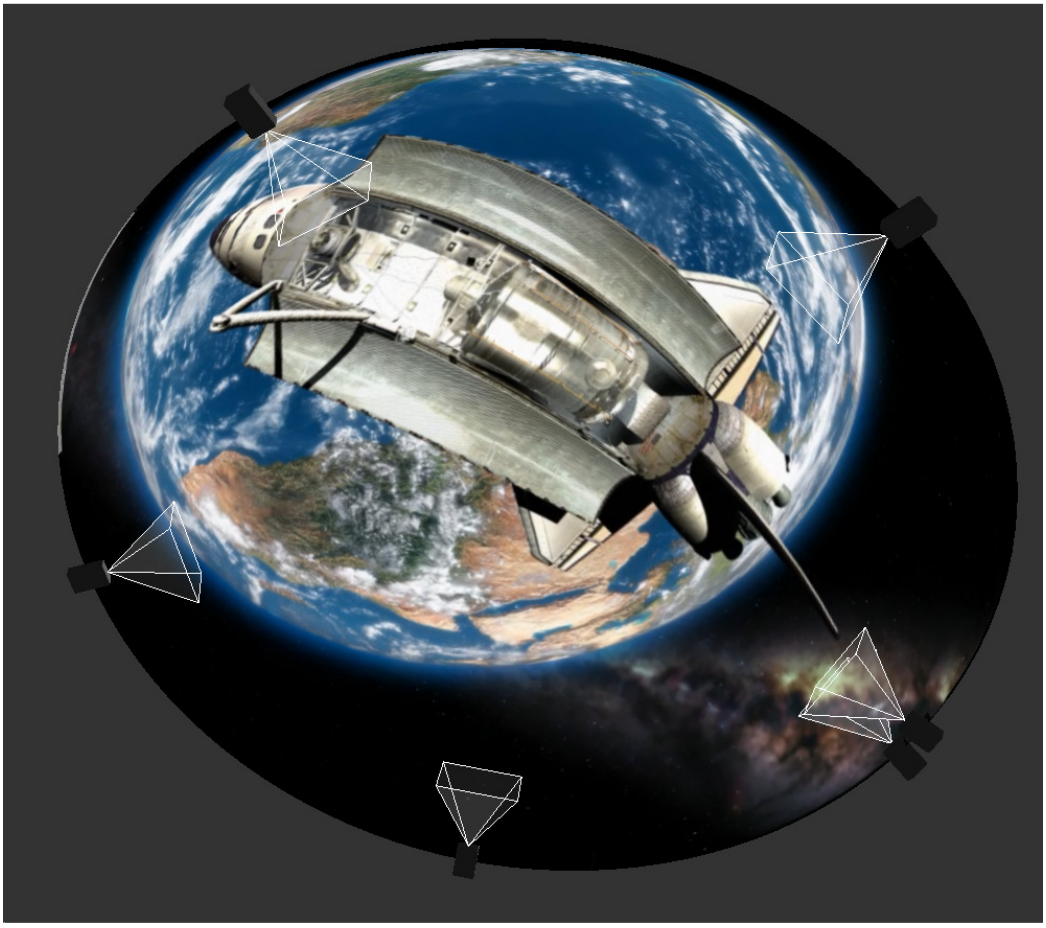
Now start the immersive Player PRO and load and start a dome master video file.

The video will be started and will open on all 6 projectors. Each projector will display the part of the video needed for the part of the screen covered by the projector.



The projected image on the dome projection screen will be perfectly aligned and soft-edge blended.





12 3D engine multi frustum configuration

For FSX, Prepar3D, and other 3D engine configuration based on *_multi.procalib and *.frustums.xml file refer to “Immersive Calibration PRO Step By Step Guide - NoCAM.pdf” file.