

Software User Manual

Thank you for using our company's Kleader projection mapping software. Kleader is designed for quick deployment, simple configuration, and convenient debugging. It features multiple window openings, and multi-device cascade frame synchronization, making it easy to create ultra-large format displays. It supports video fusion mode and desktop blending functions under NVAPI and Win DWM modes. The software can be combined with ultra-large screens to complement industry application scenarios such as radar interaction, flight simulation, and system emulation. It supports smooth playback and decoding of common H264/265 encoded 1080p to 8K videos as well as JPG and TIFF images. It also supports NVidia hardware decoders and GPU-accelerated rendering for the smooth decoding and playback of ultra-high-resolution HAP encoded videos. The playback core additionally supports HLS-based network stream decoding and output.

1. Computer Configurations

Recommendations for Fusion computer within 4 Screens:

【Processor】 : I5- 10400F or higher

【Motherboard】 : MSI

【Memory】 : 8GB

【Hard Drive】 : 240G Solid State Drive

【Graphics Card】 : NVIDIA Quadro T1000 4GB + includes active MINIdp to HDMI adapter *4 【Operating System】 : Windows 10/ 11 Professional Edition

Recommendations for Fusion computer within 8 Screens:

【Processor】 : I7 10700F

【Motherboard】 : MSI

【Memory】 : 16GB (8*2) DDR4

【Hard Drive】 : 240G Solid State Drive

【Power Supply】 : 650W

【Graphics Card】 : NVIDIA Quadro A2000 6GB + includes active MINIdp to HDMI adapter *2 【Ultra HD Splicing Processor】 : Two Inputs and Eight Outputs

【Operating System】 : Windows 10/ 11 Professional Edition

Note: Graphics cards and computer systems must be purchased with the specified models, while other hardware configurations can be similar. For configurations beyond 8 screens, please consult with sales personnel.

2. Software Registration

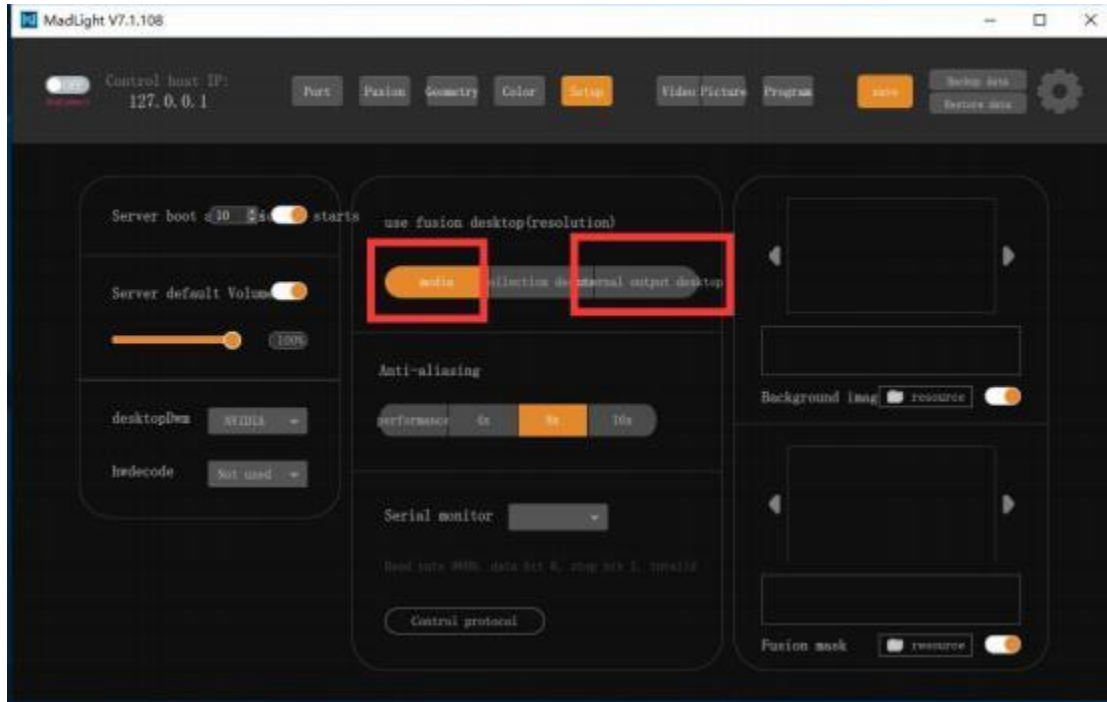


Double-click the BlendSoftServer icon, take a photo of the machine code in Zone 2, send it to the salesperson, then input the serial number in Zone 3, and finally click on Zone 4 to confirm.

3. Fusion Software Debugging Video:

<https://www.klmultimedia.com/Fusion-soft-setup-video.html>

Fusion Mode Switching



Within the Fusion desktop, you can switch between Media and Internal Output Desktop modes. Both modes can be selected when only playing videos, but when interacting, you must switch to Internal Output Desktop mode.

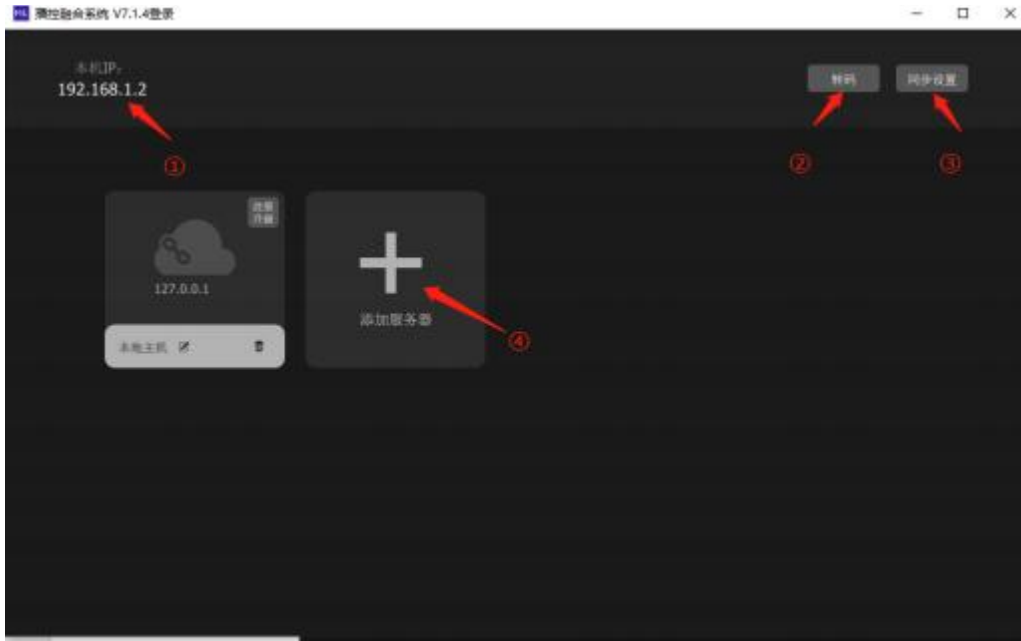
Note: Although the screenshots of the following software are in Chinese, there is an English version of the software available. For more details, please refer to the [projection mapping software video tutorial](https://www.klmultimedia.com/Fusion-soft-setup-video.html).

<https://www.klmultimedia.com/Fusion-soft-setup-video.html>

4. Software Debugging

Home Page

The system adopts a network-based approach for fusion image debugging. Before starting the debugging process, please ensure that the "Debugging Client" and "Server" programs are on the same "Local Subnet". The server host must have its firewall and other third-party interception software disabled to ensure normal communication between devices.



- ① Debug Host IP
- ② Video Transcoding Program
- ③ Multi-Device Frame Synchronization Settings
- ④ Add a Debug Server

To add a server, click the “+” button, enter the IP of the server you wish to debug, or add the server by refreshing the server list.



- ① Input or choose the server IP
- ② Customize server name
- ③ Refresh to find available servers in the LAN

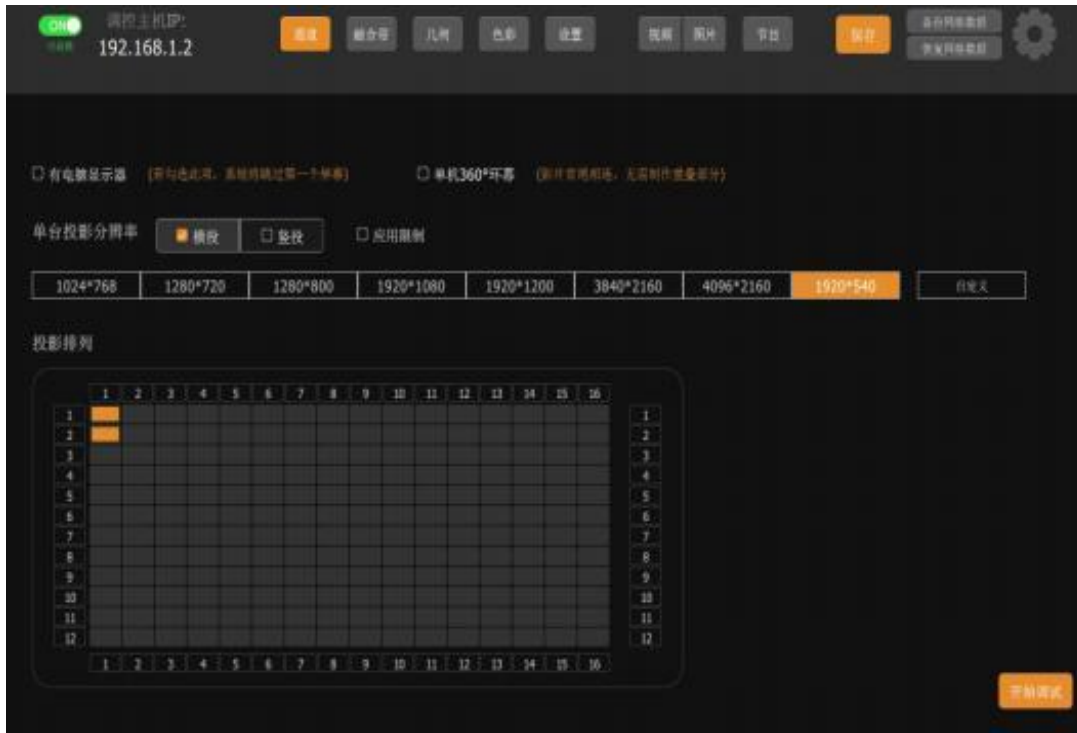
Double-click on the server tag that was just added, and the software will commence automatic connection to the server. Upon successful connection, a **【green】** indicator will show the connected status, while a failed or disconnected status will be indicated by a **【red】** indicator.



- ① Server Connection Status
- ② Debugging Toolbar
- ③ Playback Toolbar
- ④ Backup System Toolbar
- ⑤ Display Options
- ⑥ 360° Panoramic Configuration
- ⑦ Projector Array Mode
- ⑧ Remove System Restrictions
- ⑨ Device Resolution, Layout, and Custom Resolution
- ⑩ System Initialization Button

Fusion - Channel

Each fusion device is considered as one channel. After selecting the "Channel", we can configure the system monitor, projection mode, array mode (horizontal or vertical) custom resolution, panoramic screen, and channel arrangement settings.



Once you have ticked the monitor choice and set the orientation (horizontal or vertical) and resolution, you can select the $n \times n$ array layout and then click on “Start Debugging” to proceed with the following steps.

Fusion - Fusion Zone

The area where two devices overlap by $\geq 20\%$ to 50% is referred to as the fusion zone. A single channel device is displayed with a 20×20 grid. The size of the **【Fusion Zone】** can be determined based on the actual light path on site. If the minimum requirements are not met, you may need to adjust the position of the projector or replace it with a lens with smaller parameters.

- ① Fusion Zone Schematic
- ② Global Setting Mode
- ③ Customize the number of fusion grids on the top, bottom, left, and right for individual devices
- ④ Automatic coordinate calculation or manual input modification (for special cases)
- ⑤ Display grid and background still frame
- ⑥ Turn the channel image display on/off



The number of grids in the fusion zone should be set based on the actual number of grids that can be fused on-site, which is not a fixed value. For optimal results, it is recommended to set this number between 20% to 50% (4 to 10 grids). The same number of grids should be used on both sides of the fusion equipment, and special edge fusions can be customized as per the site conditions.

CAVE Coordinates

In special cases, such as with CAVE systems, it may be necessary to edit or import a pre-calculated coordinate file. First, switch to the "Fusion Zone" and turn off the ① "Automatic Fusion Coordinate Calculation" option. Then click on the ② "Edit" option to pop up the corresponding channel parameters, where you can manually change to the required values. Alternatively, you can ④ "Import File" to bring in the edited file by clicking import, or "Export" to save the current coordinates.



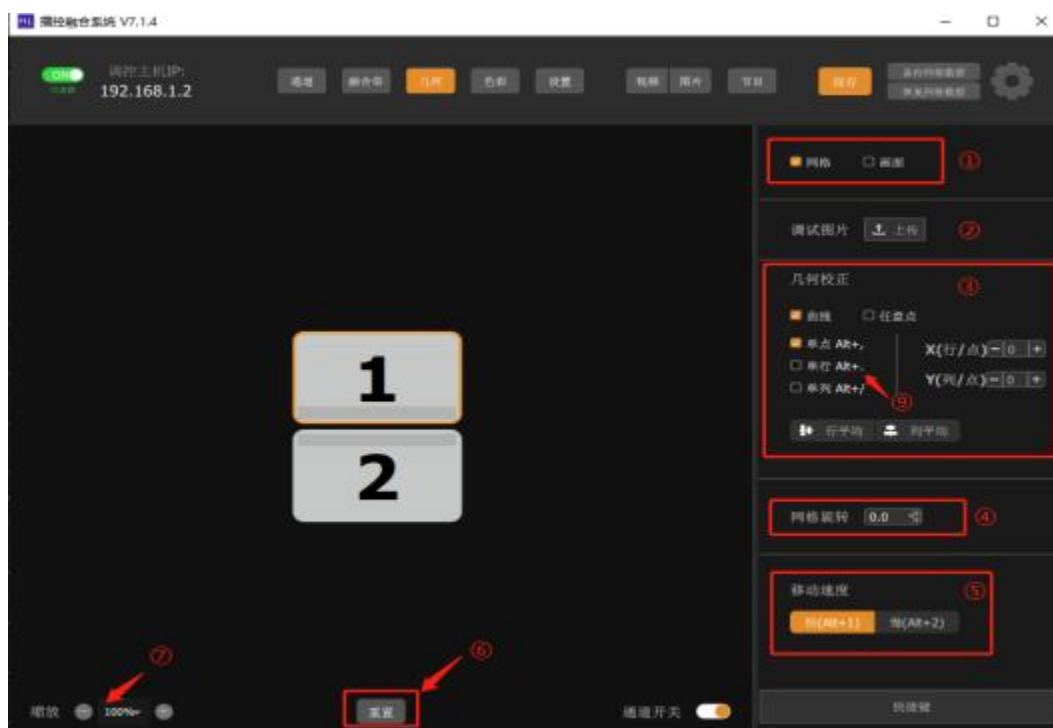
Note: Coordinate data needs to be accurate to six or seven decimal places, for example, 0.1234567.

Fusion - Geometry

Geometry refers to displaying a single device's 20*20 grid, which can also be done by adding a still frame as a reference for debugging. Adjustable points are displayed as flashing green dots. Taking the center point of the screen and the midpoint between two grid points as references, you can gradually increase or decrease the movable debugging points along the X/Y axis. In the "Geometry" settings, we can:

- ① Turn on/off the grid or still frame display.
- ② Upload a still frame image for debugging.
- ③ Move by row, column, or single point during debugging.
- ④ Switch between curve/straight line modes, increase the number of adjustable points for rows or columns, and set the debugging mode for any point in the entire grid.
- ⑤ Adjust the overall rotation angle of the device.
- ⑥ Set the size of the step distance when moving points during debugging.
- ⑦ Initialize the device grid.
- ⑧ Display system shortcut keys.

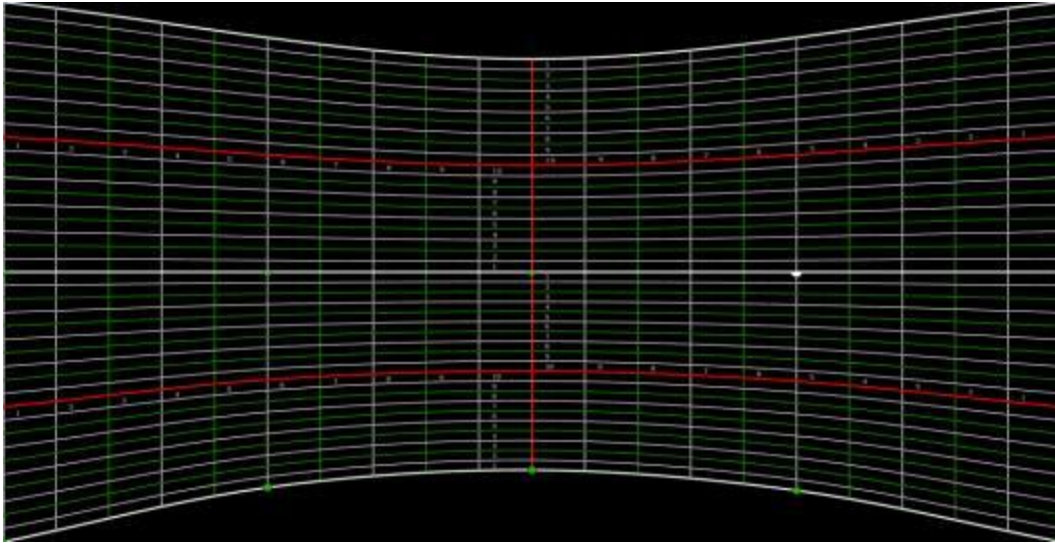
These functions and settings provide operators with flexible tools for precise image fusion adjustments.



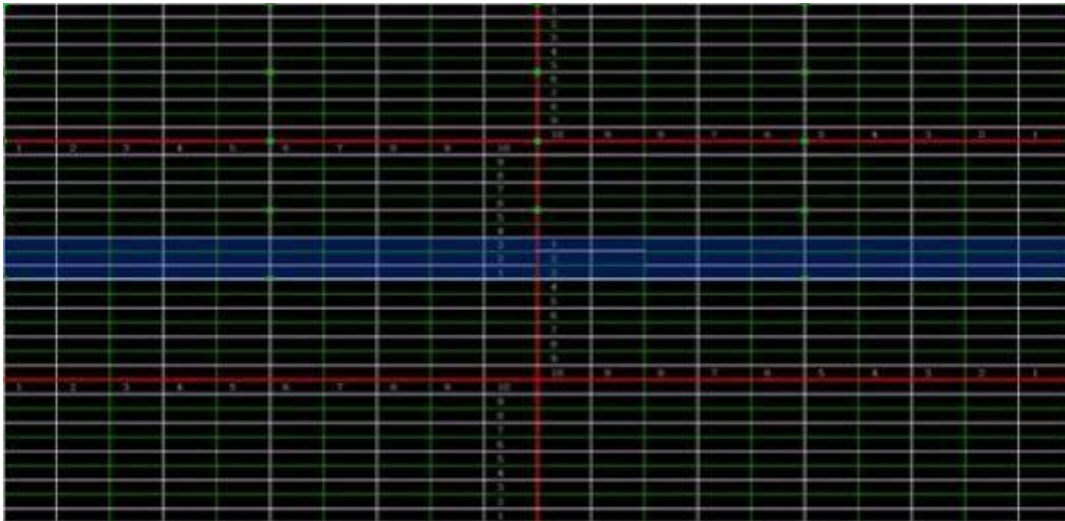
The system has built-in curve (arc-shaped) and straight line debugging modes, which can be adjusted according to actual needs. Switching between the two can cause loss, resulting in partial distortion of the image; please decide in advance which method will be used to adjust the grid. "Any point" refers to single-point adjustments, which is the maximum level of adjustment within the system. Please use discretion based on the on-site situation.

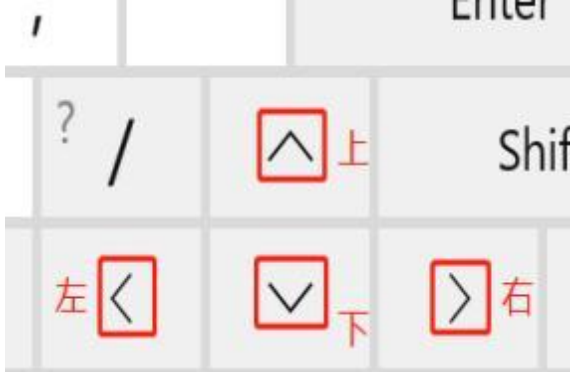
曲线 任意点

Curve Adjustment: Suitable for arc-shaped fusion and irregular shape debugging, it provides a faster rate of arc formation compared to straight-line adjustment.

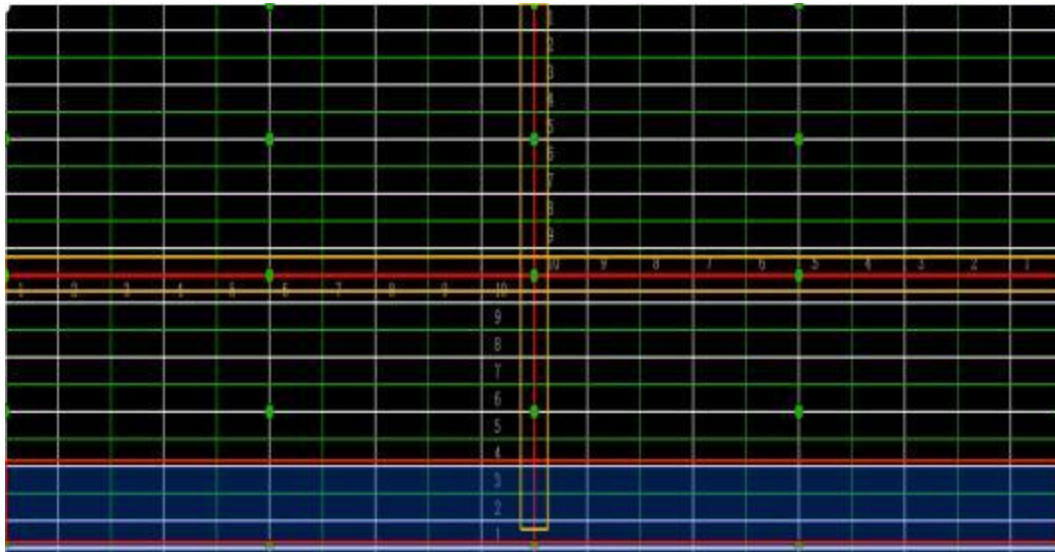


Straight Line Adjustment: Suitable for planar fusion, where lines are straight and orderly, appropriate for large areas of pure flat surfaces.

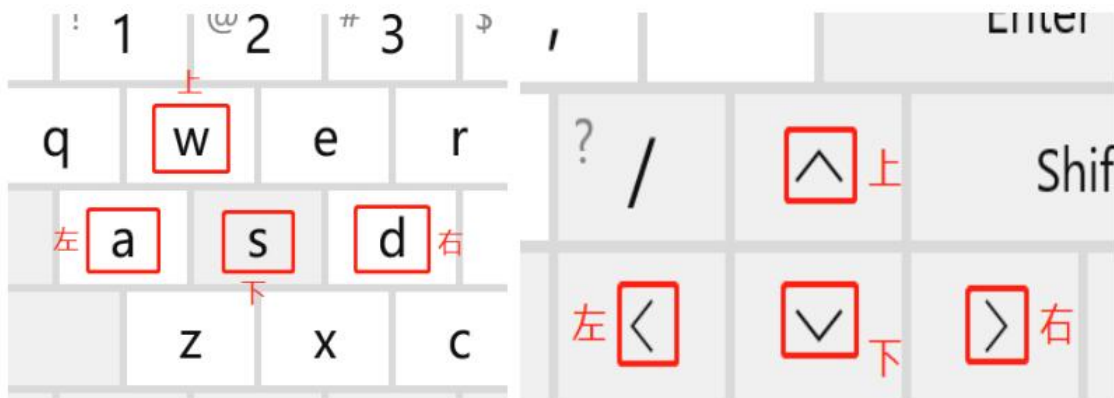




Row (X), Column (Y), Add (+) Points, Bottom Fusion Zone Indication (Blue)



During debugging, it's best to start with the fewest points and gradually add the number of adjustable points, or rows and columns, as necessary, which corresponds to the X/Y axis points. Select the point to be adjusted, and you can use the keyboard keys WSAD in combination with the numeric keypad's arrow keys (up, down, left, right) to move and adjust the point's position. The more points there are, the better the uniformity of the adjustment will be, but that doesn't mean that more points are always better; it's advisable to achieve good uniformity with the fewest points necessary.



Fusion Preparation

Firstly, it's important to understand the relationship between fusion and the computer desktop. The image is based on the desktop's starting point, with the X-axis going from left to right and the Y-axis from top to bottom. Begin by opening the computer's display settings and clicking "Identify" to tag the devices. The connected devices will be identified with a display monitor [ID]. Next, drag and arrange the identified devices in sequence, setting the furthest left screen as the primary desktop. Arrange the devices in numerical order from left to right based on their identified numbers; all devices should be "Top Aligned" to be on the same horizontal line, ensuring the projection fusion overlap is between 20-50%, which is ideal. Also, ensure that each display device's "Scale and layout" is set to 100%. Desktop fusion mode will then need to be configured in the graphics card's control panel for the corresponding card stitching.

Note: If the computer's display arrangement in the display center is identified as 1 2 3, and the order after identification is 1 3 2, then the correct arrangement of the devices should be adjusted to 1 3 2, with display 1 set as the main desktop. Apply and save the changes accordingly.

显示

重新排列显示器

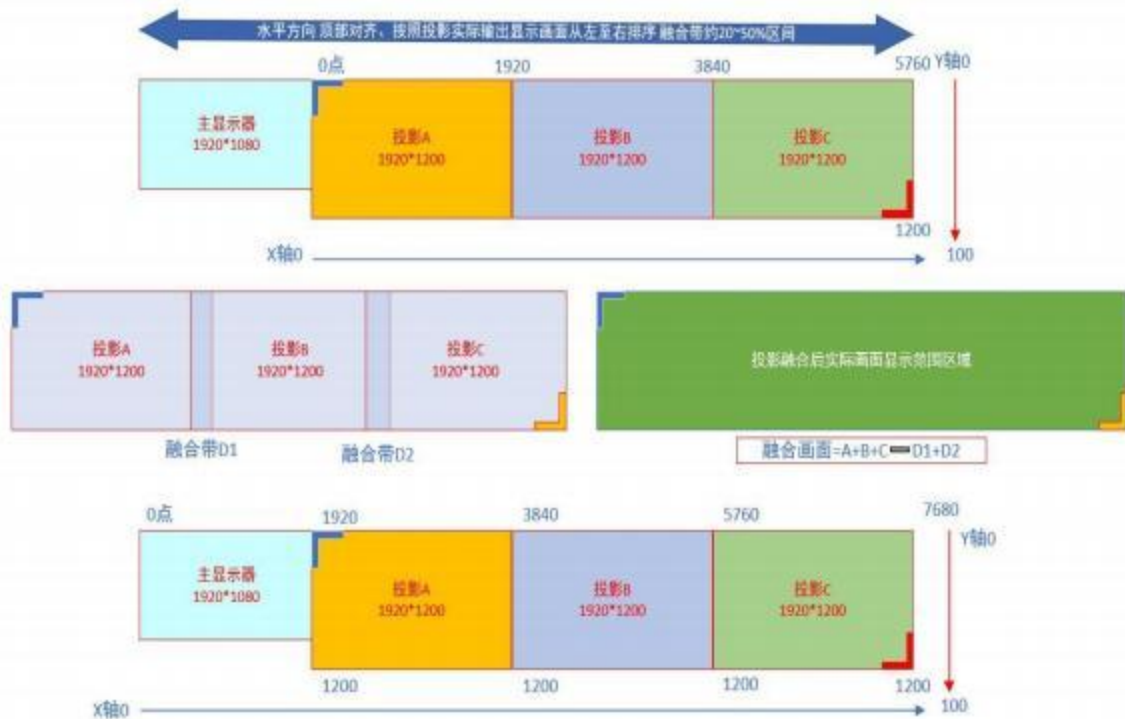
选择下面的任一显示器以更改其设置。长按（或选择）一个显示器，然后通过拖动方式来重新排列。



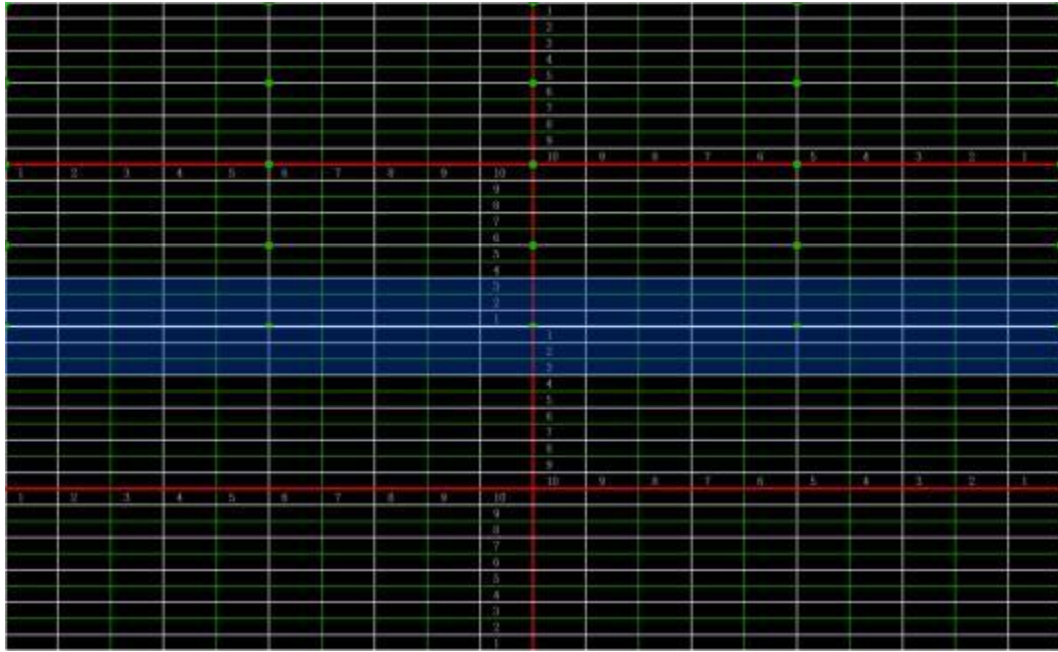
标识投影机，最后按标识出的数字从左至右排列



主显示器、自定义坐标、显示排列、XY范围、融合画面示意图



Adjustment Illustration: Taking the fusion of two devices arranged vertically as an example, first properly arrange the system display and then configure the software channels. Once the grid is displayed, the fusion zone grids, marked as 123, on the two vertically arranged devices must be perfectly aligned top to bottom, with the fusion zone lines completely overlapping. Otherwise, the fusion area will appear blurry. The rest of the grids should be evenly distributed horizontally and vertically within the image, maintaining at least no significant difference in size as a baseline. The ideal is to have uniformly sized and precisely divided grids, which ensures that the image appears seamless and without distortion. Adjusting can be done through the "Fusion Band" by regulating the brightness changes in the fusion area until the image looks optimally blended.



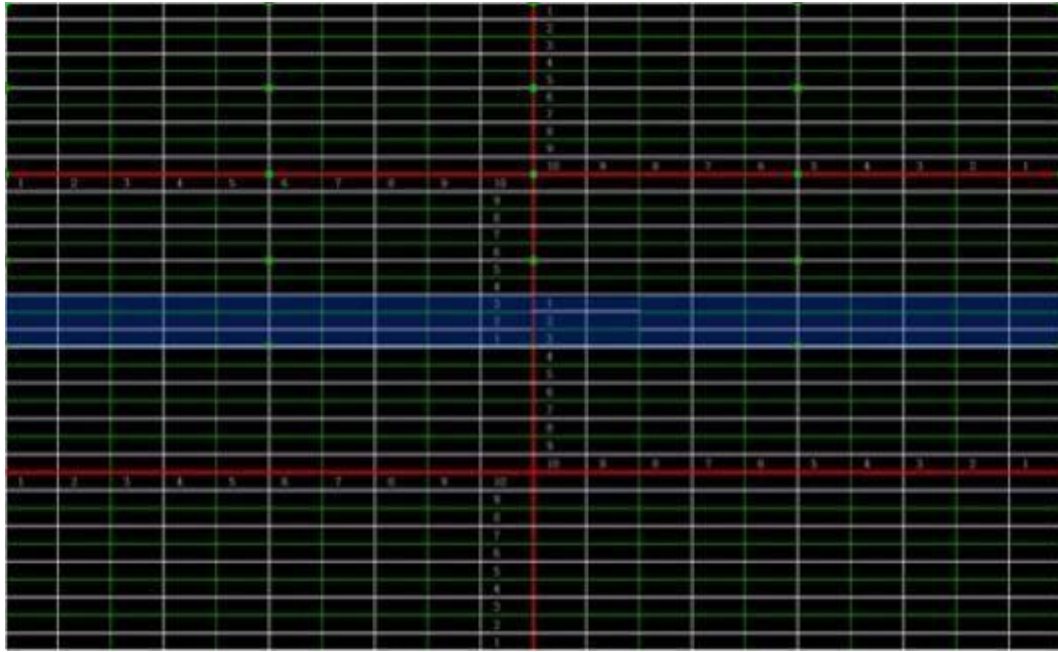
Column Adjustment: Allows for movement of the area based on a single column as the reference point.



Row Adjustment: Allows for movement of the area based on a single row as the reference point.



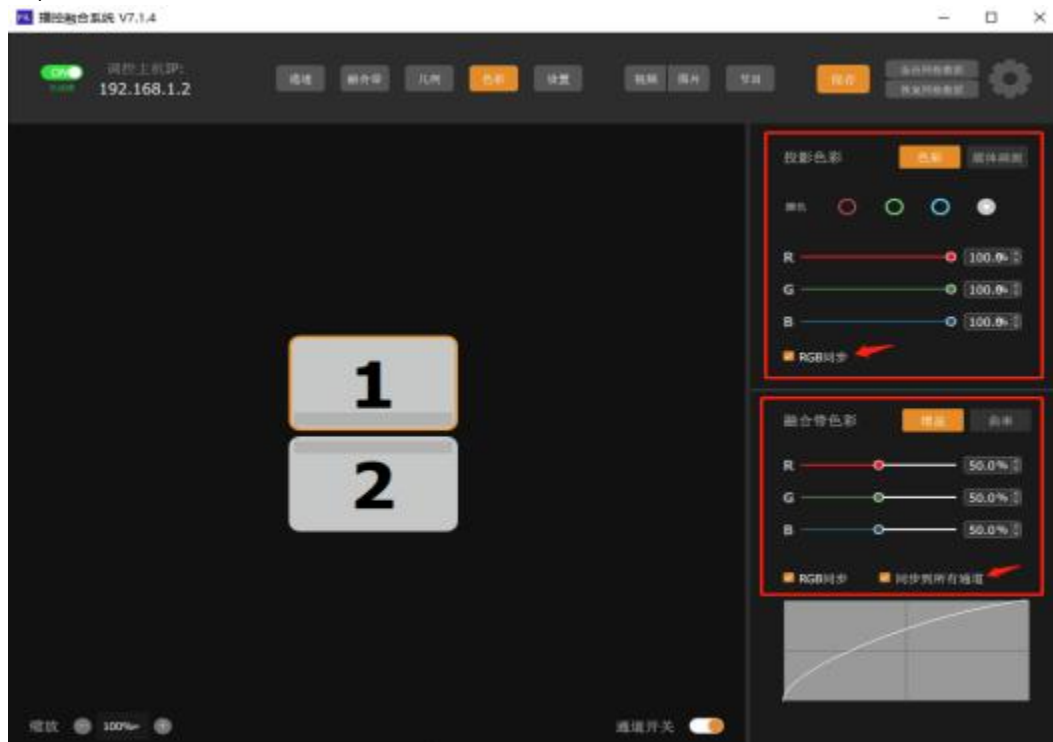
Post-Adjustment Image: The fusion band should be completely overlapped, and the grids should be evenly divided throughout to ensure uniformity.



Fusion - Color

1. By switching to the “Color” settings, we can individually adjust the R (Red), G (Green), and B (Blue) color values of a single device to address inconsistencies in screen color caused by the varying degrees of light source attenuation across different machines.

2. The brightness and contrast in the overlapping area of the screen can be adjusted by modifying the RGB values of the fusion band area. These adjustments can be seen in real time as the image changes. It is also possible to adjust the “Curvature” to modify the transition of the color changes. Moreover, the adjustment parameters can be synchronized across all display channels. The final effect should be based on the optimal viewing experience on-site, as there are no fixed values to adhere to.



The fusion band area can be adjusted to display a gradient of brightness by moving sliders. These adjustments can be made for individual channels or synchronized across all channels using the “Synchronize to all channels” feature. The goal of this adjustment is to achieve an on-site viewing experience with no color differences, without any areas appearing too dark or too pale, ensuring that the transition from left to right is natural and seamless. There are no fixed values for this; it should be fine-tuned based on the actual observed effect.



Video

By switching to the “Video” option, you can play media files. The interface includes:

System Video Resource List: A list of video files available in the system’s media library.

Playback Progress Bar: A bar that displays the current progress of the video being played.

Auto-Play Toggle: A switch that enables or disables the automatic playing of videos.

Playback and Volume Control: Controls for playing, pausing, stopping, skipping videos, and adjusting the volume.

Loop Logic Control: Options to control the looping behavior of the video, such as repeat one, repeat all, or no repeat.

Upload Media and Refresh List: Functions to upload new media files to the system and refresh the list of videos in the resource list.

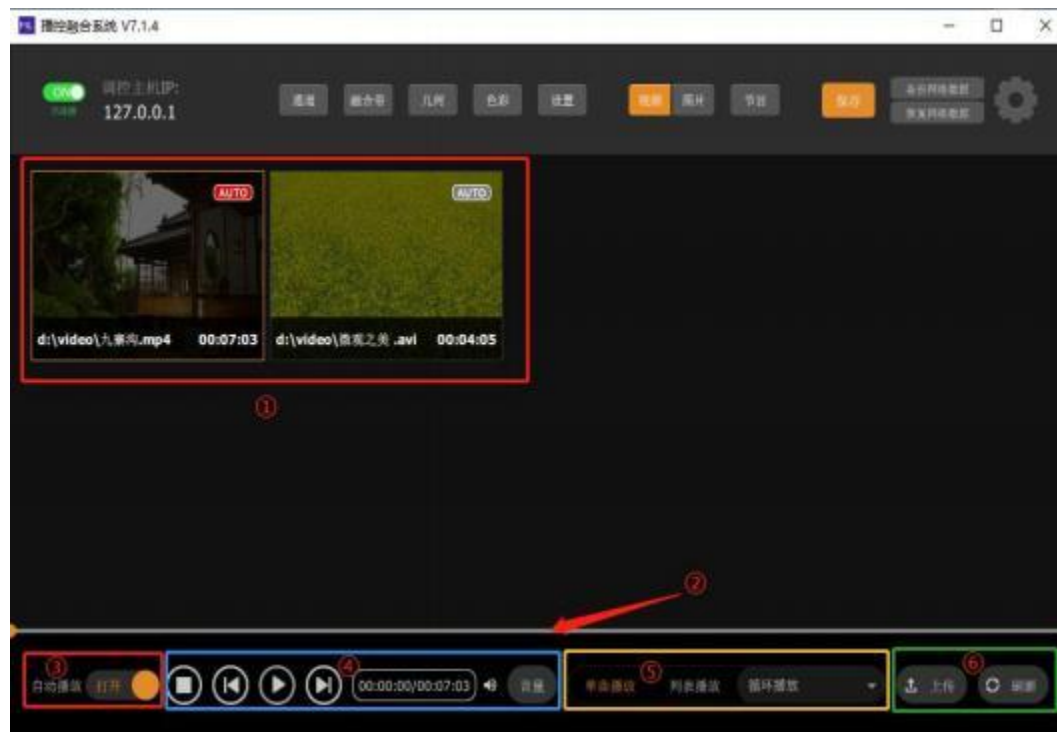
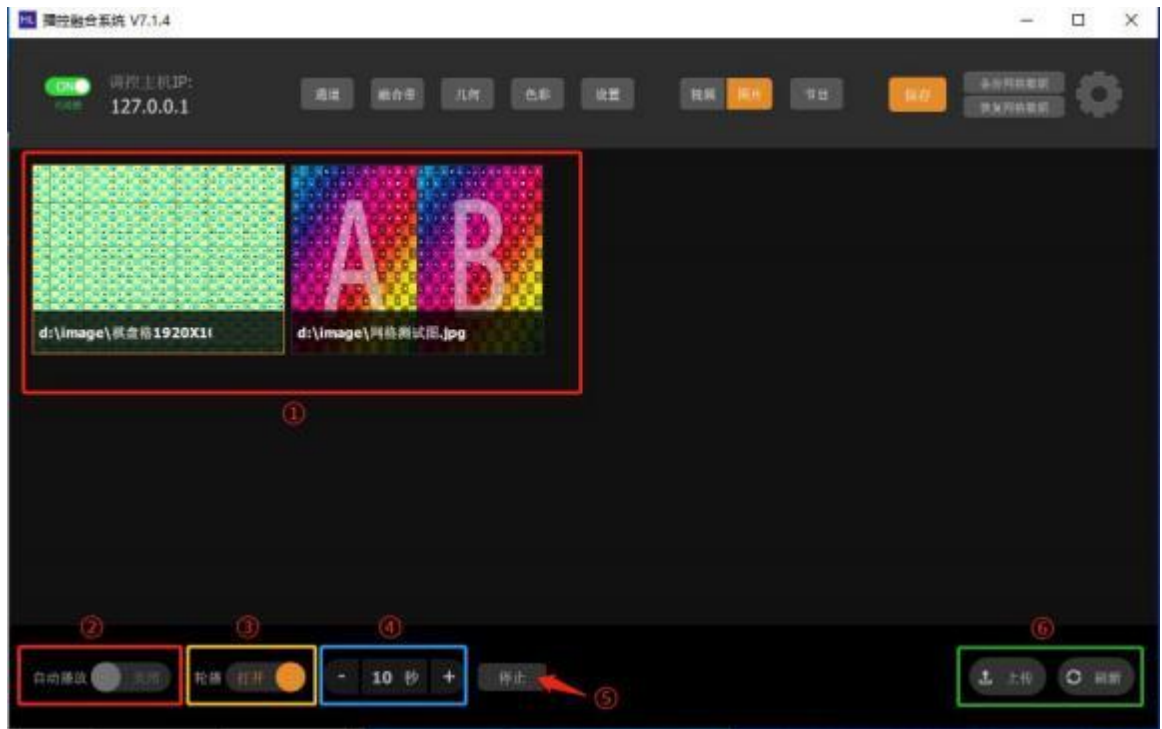


Image Playback

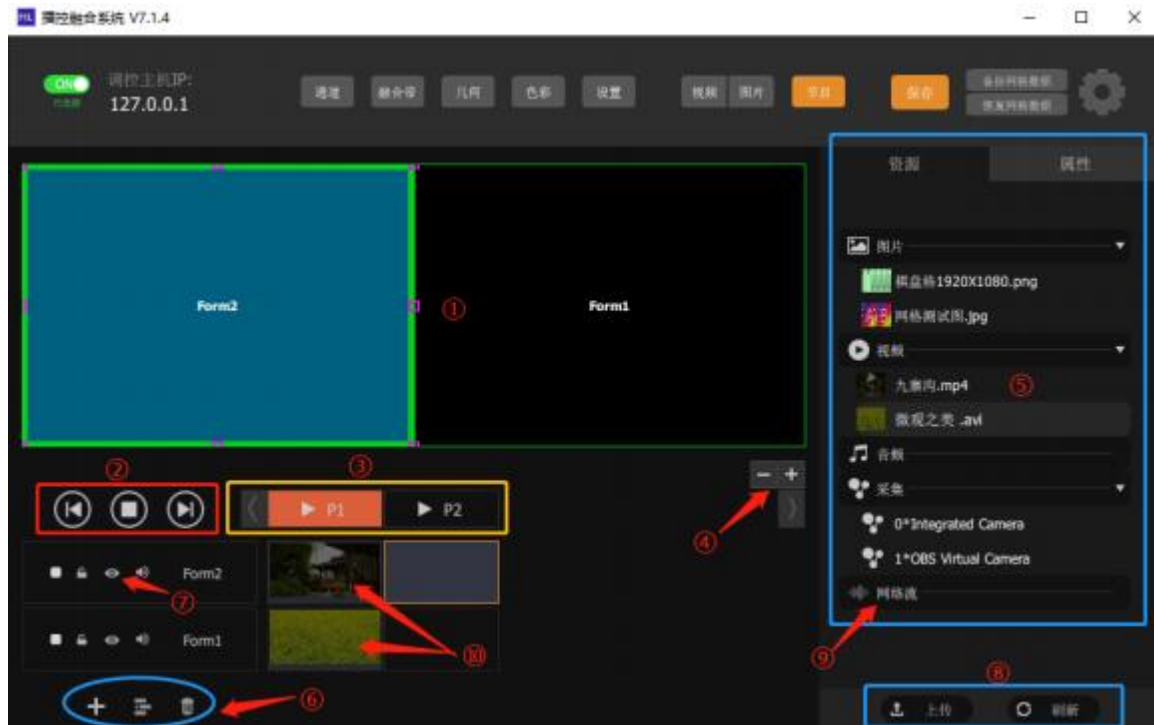
To play image files, switch to the “Image” option. ① System image resource table ② Boot play toggle ③ Slideshow: auto-next toggle ④ Set time for switching to the next image ⑤ Stop current playback state ⑥ Upload images and refresh the list.



Program Control

Under the “Program” option, you can execute complex playback control and windowing logic.

- ① Window layout area
- ② Program playback control
- ③ Program list
- ④ Add/delete programs
- ⑤ System resource library, images, videos, capture, network stream, and attribute control
- ⑥ Add/delete windows
- ⑦ Window media control
- ⑧ Media deletion and stream media editing
- ⑨ Network stream list.

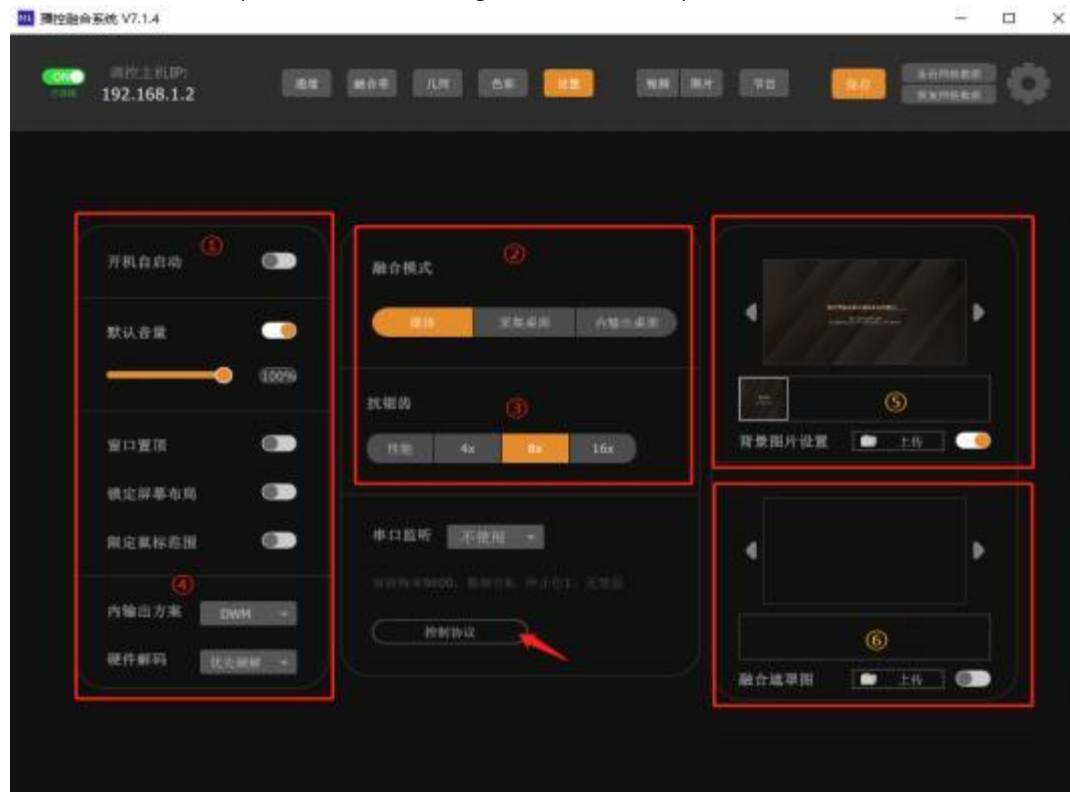


System Configuration

After completing the geometric adjustment, the screen will be calibrated. Next, proceed with “System Settings”

- ① Set whether the software auto-starts on boot (recommended to enable), default volume (recommended 50%), window always on top (enable), lock-screen layout, confine mouse range
- ② Fusion mode selection: default video fusion, capture mode desktop, NV/DWM desktop fusion
- ③ Graphics card performance mode (unsupported cards may cause

a black screen or no display issues) ④ Desktop mode NV/DWM selection, system decoding method selection (hardware decoding recommended).



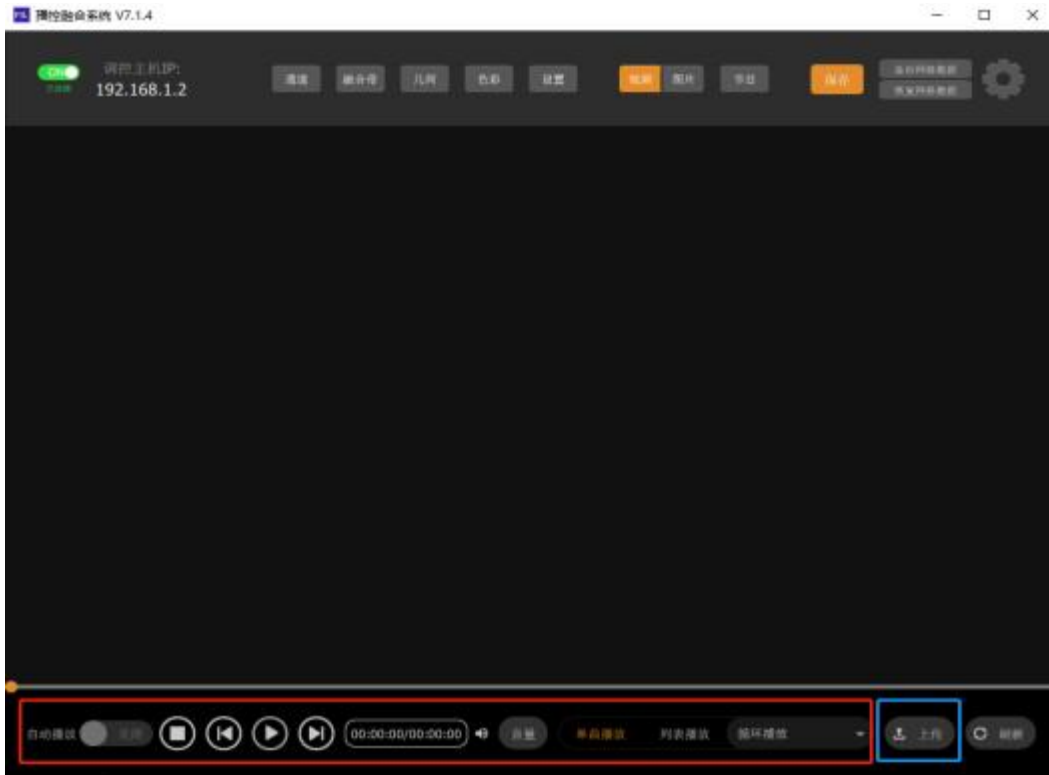
Background and Masking

For irregular screens, you can set a mask with an irregular image ⑥, as well as set a background image when stopped ⑤. Both are operated in the same way: click “Upload” to choose the desired jpg background or mask image, complete the upload, select it, and then enable the toggle.

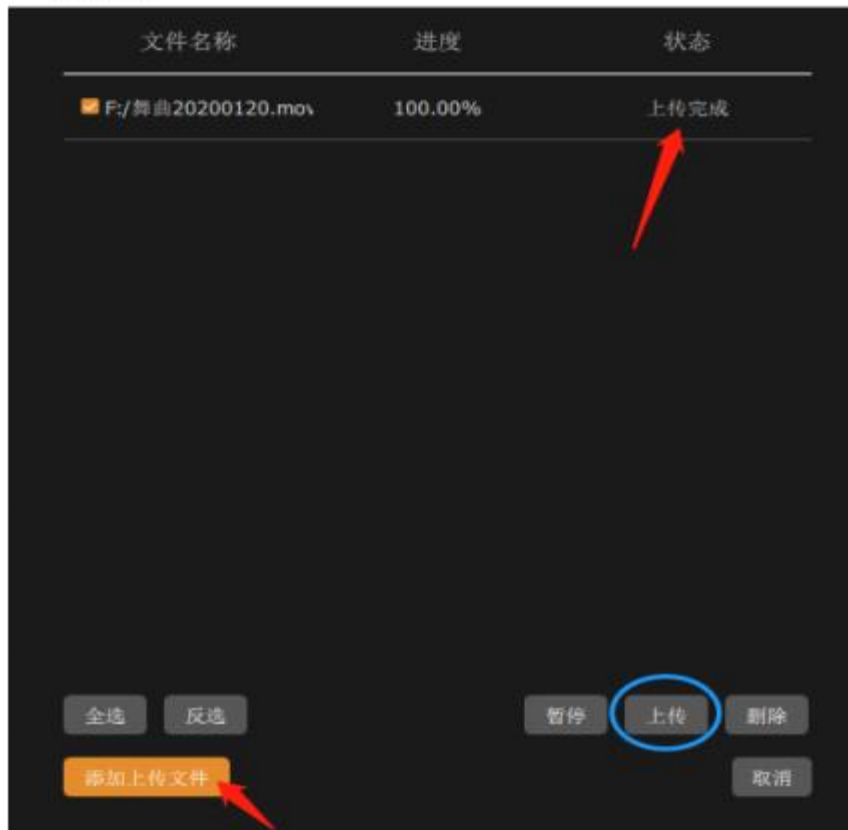
Video Playback

Switch to the “Video” tab and click “Refresh” to update the list of videos available for playback on the system. At the bottom, there are playback control, volume, and loop logic settings. First, click on the “Upload” button at the bottom right to pop up the upload control window; click “Add upload file” to browse and select multiple MP4 files for upload, then click “Upload” to start transferring to the server host. After completing, click the refresh button to refresh the list of video resources available for playback in the system. Select and click to start playback, or use the control logic below to play a single loop or playlist and looping logic such as ① loop playback ② show the first frame after playing ③ show the last frame after playing ④ stop after playing to control the overall playback logic.

Note: The system default path is the D: \VIDEO folder. If there is no D: drive partition, please manually create one using disk management tools. If files do not display after uploading and refreshing, it may indicate that the file cannot be correctly decoded. Please transcode to MP4 or hap before re-uploading.



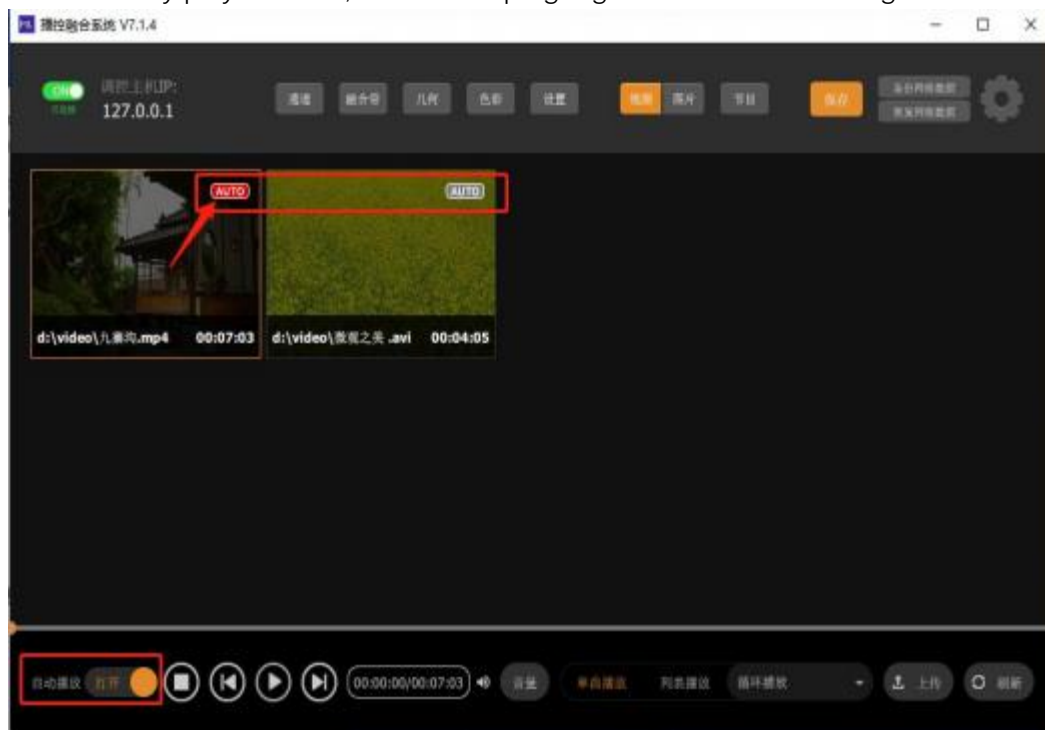
添加输出



Video encoding recommendations: $\geq 720p \sim 4k = H264$, $\geq 4k \sim 8K = H265$ encoding, or transcode to mov with hap encoding; this ensures proper hardware decoding, which depends on the NV graphics card Decode decoder hardware performance. Hap is uncompressed, with file sizes about $\geq 10:1$ larger than H264 encoded videos. Please be aware of the available disk storage space on the server. HAP uses GPU for decoding, and its performance depends on the graphics card's 3D rendering capabilities.

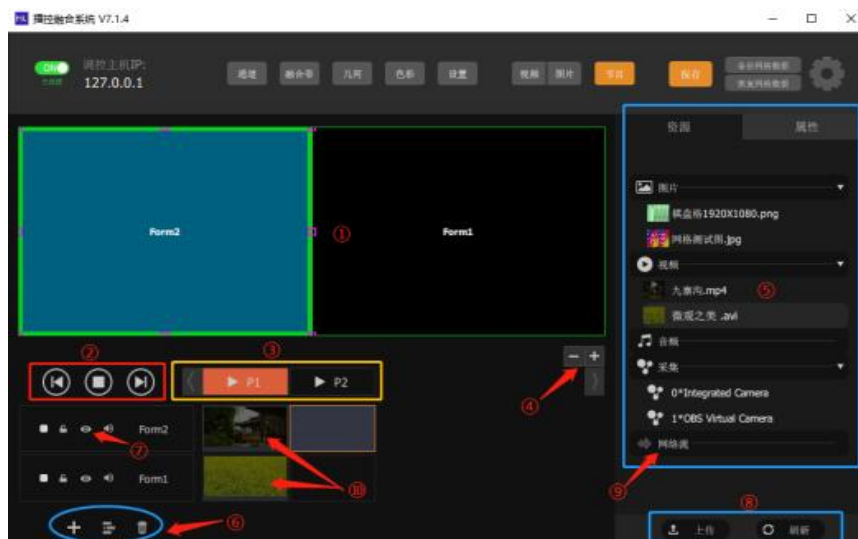
Boot Play

Turn on the autoplay toggle, select the media to play which will show an AUTO flag in the top right corner. Click to activate it, turning it into a red style. After saving, the file will automatically play on boot, and the looping logic can be set according to the rules.



Program Management

Programs support complex logic and can be operated to open windows, load captures, cameras, hls video streams, etc.



Firstly, add the required number of windows, for instance, splitting into two by adding two windows with ⑥, then click ⑦ to switch to the specified window, click ⑤ to switch to the properties bar to modify the window width to 50%. Sequentially adjust the second window width to 50% and X position to 50%; this creates two equally divided screen areas. Drag and drop the videos that each window needs to play from ⑤ to the ⑩ position, click ③ to play the program normally. Control individual media sound and display lock through ② for program logic and ⑦ for individual media control. Right-click on media to set the post-playback operation logic.

Desktop Fusion

When running radar or virtual VR desktop programs, a video fusion environment is not sufficient for windowed operation; at this point, you need to switch to desktop fusion mode. The geometric calibration method is the same as the above video fusion steps, just with an additional splicing step. In the graphics card control center, you need to set up mosaic or surround graphics card splicing. After splicing is complete, finally, click "Settings" under fusion mode and select the "Inner Output Desktop" mode to save.

NV Mosaic

Mosaic is a feature exclusive to NV enterprise graphics cards, allowing multi-card (+ sync card) and multi-output support for massive display screens up to 32*32k.

NV Surround

As this technology is intended for home use, the maximum supported splicing size is 3 monitors.

EDID Locking

EDID contains display device specifications, refresh parameters, etc. Locking the EDID information can simulate that the device is always online; this prevents software from failing to fuse, misaligning fusions, or displaying anomalies due to channel loss.

First, open the NV graphics card driver center, find the "System Layout" option, and click on the EDID word in the device bar to pop up the EDID management window.

Select the output device then export the device's EDID to a file, click export to choose a save location, then switch to the "Load" tab to find the exported file and import it, check the channels you need to load to complete the loading project. At this point, the system display binding information will change to the file, indicating successful binding.

Note: Once the desktop fusion system is set as a large desktop, it cannot be used simultaneously with other monitors.

System Backup

Automatic Backup:

After fusing, the grid configuration can be backed up into a single database file using "Backup Grid Data" and "Restore Grid Data." This allows for quick and easy restoration to a new host server in case of system issues, without the need for complex reconfiguration.

This concludes the translation of the projection mapping software tutorial.



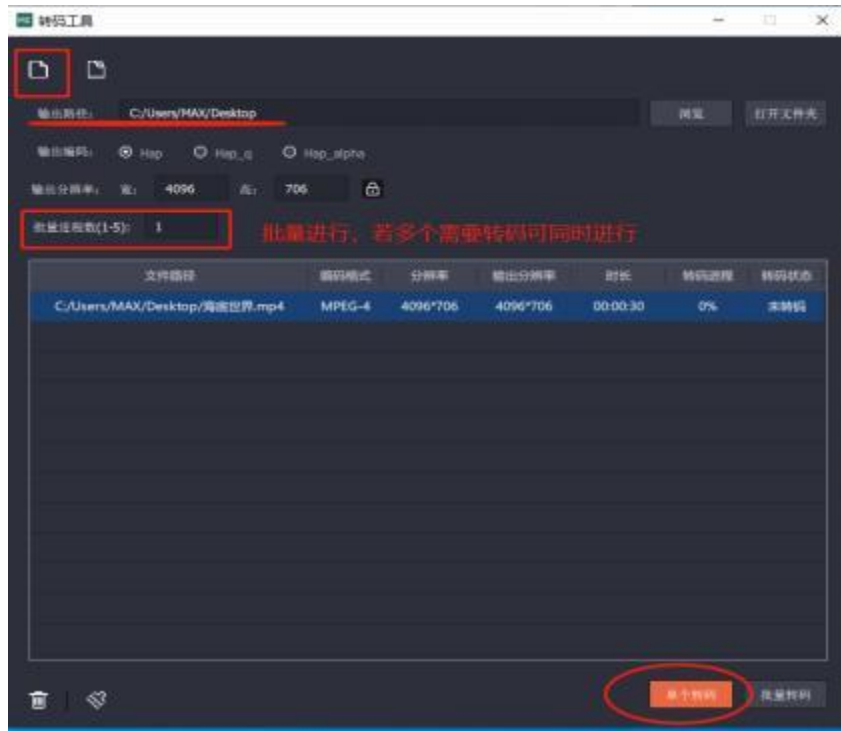
Due to the fusion program running on top of other windows when the system is operational, we are unable to manage the computer as needed at that time. To minimize the fusion window, press CTRL+F2. To maximize the fusion window, press CTRL+F3. Displaying the desktop afterwards facilitates quick access to manage the server host normally.

Note: The backup files include the system's overall configuration file. In cases such as cross-version upgrades, issues such as abnormal black screens or incompatibility may occur after importing. It is recommended to also manually back up the independent grid data files separately for convenient restoration.

File Transcoding

Due to the possibilities of playback stutter, audio-video desynchronization, and other issues that can arise from media with high resolution or bitrate encoding, we can utilize the software's optimized decoding by transcoding the video into an MOV encapsulated HAP format. Click on "Transcoding" in the client's homepage bar, find the file you want to transcode, and you can also batch transcode multiple files at the same time. Click on single/batch transcoding to start the process, and after completion, upload the transcoded files.

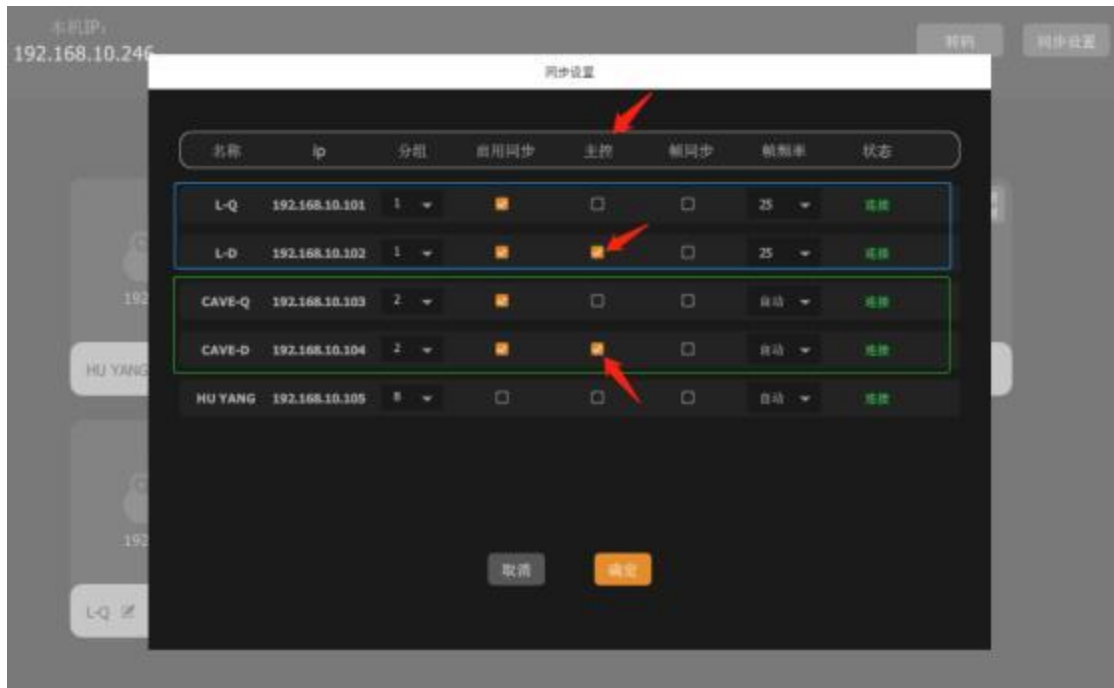




Note: The transcoded files are MOV files encapsulated in the HAP format, which are typically very large in size. It is advisable to perform the transcoding directly on the server side and ensure that there is sufficient disk space prepared in advance. The system's default location for storing uploaded files is the D: \VIDEO f older. Be mindful to reserve enough storage space. Alternatively, you can directly use MP4 video files encoded in hardware-decodable H265 or H264

Video Synchronization

For projection mapping applications such as CAVE or sand tables, it's common to use dual or multiple servers for synchronized playback. First, we need to set up a synchronization group for the servers. Click on the "Synchronize" button on the homepage. The system will search for available servers on the network. Select the two server IPs that you need to synchronize, check the "Enable Synchronization" button, and set one server as the master server. Different groups should have different IDs to prevent interference, while any servers not involved in the synchronization should be set to any other arbitrary group; this ensures normal operation of the synchronization. The standard for synchronized playback files: All hosts involved in synchronization must use the same filename, same type of encoding, same duration and size, and the same frame rate. For better results, you may opt for a more refined frame synchronization mechanism (optional) .formats.



Central Control Protocol

The system supports integration with common central control systems to manage media playback control, supporting protocols such as RS232, TCP=3011, and UDP=3012; sending the appropriate [string] commands will allow us to match the central control logic as required. Common controls are as follows:

Load video and play immediately

a) videoUpdate xxx - where xxx is the complete name or path of the video

Video play command

a) videoPlay

Video pause command

a) videoPause

Video stop command

a) videoStop

Video previous track command

a) videoPrev

Video next track command

a) videoNext

Video single play

a) videoOne

Video playlist play

a) VideoMore

Set to image slideshow mode

a) imageStartLoop

Stop image slideshow mode

a) imageStopLoop

Media mode

a) renderMedia

Capture desktop

a) renderCaptureDesktop

Output desktop internally

a) renderOutputDesktop

Play program

a) Send command: PlayProject xxi - where Xx is the program number

Pause program

a) Send command: PauseProject

Stop program

a) Send command: StopProject

Program - next track

a) playNextProject

Program - previous track

a) playPrevProject

Increase system volume

a) Send command: InsSystemVol xx - where xx is the percentage

Decrease system volume

a) Send command: DesSystemVol xx - where xx is the percentage

Mute/unmute system volume

a) Send command: MuteSystemVol xx - where xx is 1 to mute, 0 to unmute

Restart server

a) Send command: RestartServer

Synchronization control

a) Send command: SetVideoSync x - where X=1 enables synchronization, X=0 disables it

Minimize window

a) Send command: MinWnd

Restore window

a) Send command: RestoreWnd