ColorSpace Point by Point Calibration Instructions

Based on ColorSpace 2.83.26

（2021.6）

目录

I. Installation of the camera

1. The distance between the camera and the screen should ensure that the camera can obtain images of the entire screen, adjust the height of the tripod so that the position of the camera and the center of the screen have the same height, regulate the tripod to horizontal position.
2. Install the camera on the quick release plate, rotate rockers of the tripod so that the camera lens aims at the center of the screen. If the camera lens is zoom lens, rotate the zoom ring so that the camera lens is the shortest.
3. Remove the camera lens cover. Remove the filter if the screen is not light enough.
4. Use a data line to connect the camera and the computer, connect the camera with the power supply.

Zoom ring   Focus ring   Aperture

Zoom ring   Used to change the focal length of the lens, that is, to change the angle of view of photos and the size of the subject being photographed (angle of view changes with different focal lengths). Due to fixed focal length, fixed focus lens, cannot zoom, that is, doesn't have zoom ring.

Focus ring   Used to change the distance between the clearest plane and the lens, that is, to change the definition of the subject being photographed. Scale marked above indicate the distance between the clearest plane and the lens.

Aperture   Used to adjust the amount of light entering the lens. The bigger the aperture is, the more light enters the lens. The smaller the aperture is, the less light enters the lens.

The three knobs under the quick release plate are used to control the position of the camera. By rotating these three knobs, the view of the camera changes in the following directions, up and down, left and right, clockwise and anticlockwise.

Up and down

Clockwise and anticlockwise

left and right

Connect the USB port into bottom of Camera left socket and 12V port

into bottom of Camera middle socket

Another USB port connect into computer USB socket

II. Operation procedure of software

1. Connect the screen to the computer running ColorSpaceServer, open ColorSpaceServer

Software includes ColorSpaceServer (Server) and ColorSpace (Client), versions of both should be the same (at least, the first two numbers should be the same). Open ColorSpaceServer at Server computer. If the resolution of screen is lower than that of the Server computer, select **Extend these displays** for Multiple displays in Screen Resolution; if not, select Duplicate these displays. Select the highest resolution. Setting under windows 10 is as follows:
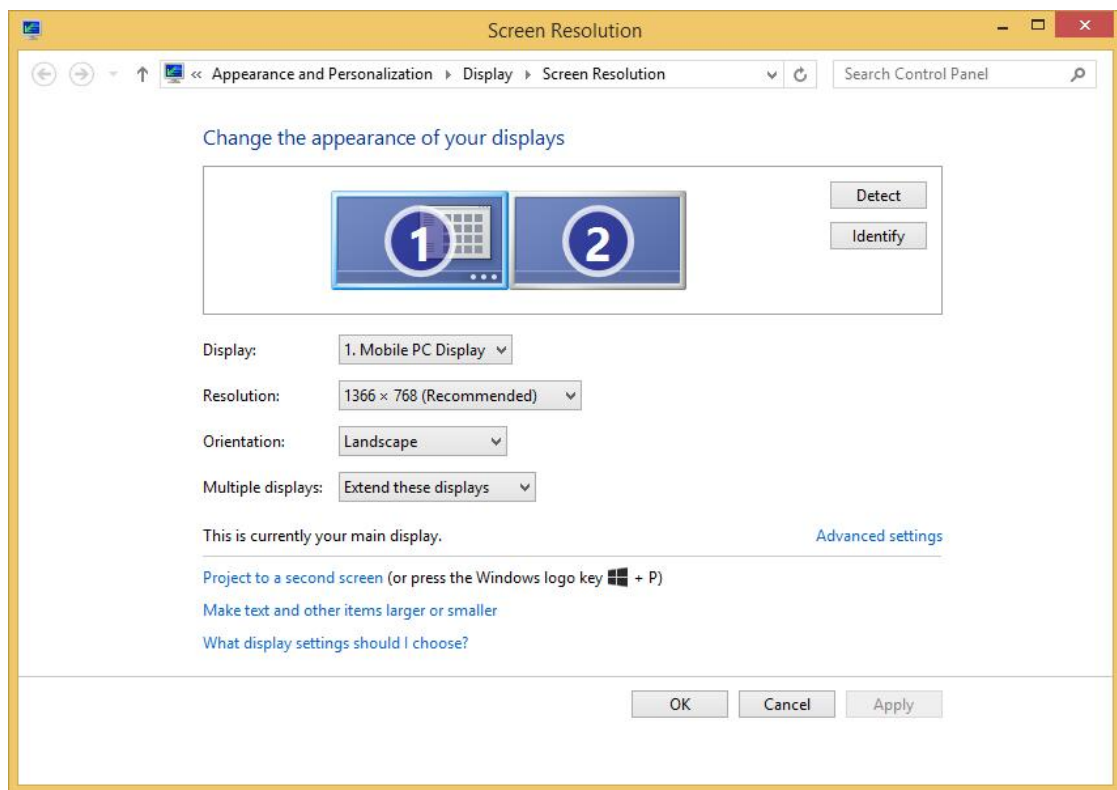
2. Set up sender or video processor so that the screen corresponds with the computer point by point

Setting for input: resolution for input of sender or video processor should be the same as the resolution of Server computer.

Setting for output: if the resolution of screen is lower than that of the Server computer, resolution for output should be the same as the resolution of Server computer. If not, divide the whole screen into several areas, set resolution for output to be the same as the resolution of Server computer, set start points of these areas to be the same point of Server computer so that the screen corresponds with the computer point by point.

3. Open ColorSpace on the Client computer

Path of the project   Connection and state of the camera   Coordinate of mouse cursor

4. File—New Project

File—New Project. If we selected Extend these displays before, Screen—Start X should be the number of horizontal pixels of the Server computer, Screen—Start Y should be 0, Screen—Width (respectively Screen—Height) should be the number of horizontal (respectively vertical) pixels of the screen. Display area should be the area that could be photographed, that is, the area apart from the bordure that couldn't be photographed. If the width of the bordure is k pixels, Display area—Start X and Display area—Start Y should be k, Display area—Width (respectively Display—Height) should be the number of horizontal (respectively vertical) pixels of the screen minus 2k. Module—width (respectively Module—Height) should be the number of horizontal (respectively vertical) pixels of a module. If we selected Duplicate these displays before, the only difference is that Screen—Start X should be 0. Check **Exposure Color—Red, Green and Blue**. **Correct—Chrome** is used for calibration of chrome and luminance, Luminance is used for calibration of luminance only, antijam is used when there are interferences, high-accuracy is used for calibration of high-accuracy. If we know the resolution of the screen, select **Location—Accurate location**, when location carry out, the result obtained will be compared with the result that should be obtained, if the two results aren't the same, software would change algorithm so that the two results could be the same, if they're still different, this mistake would be reported by the software. If we don't know the resolution of the screen, select Blur location. If a part of the screen is covered, many rows or columns of LED can't be completely photographed by the camera, select Line location. If the calibration carry out in the factory, select Reference cabinet to ensure that the following cabinets display the same as a certain number of

cabinets calibrated; if the calibration carry out at the scene, several cabinets break down and are replaced, select Consistent comparison to ensure that cabinets replaced display the same as the original screen. If there's no exception or we use the software for the first time, select **Single correct**. Select **Temperature** and the camera photograph when CCD is at this temperature. If the resolution of screen is higher than that of the Server computer, don't check Chink after correct; if not, check **Chink after correct**. If the calibration carry out in the factory and the name of calibration data file had better include the serial number of cabinet, check Scan code; if calibration data files should correspond with modules of cabinet, enter Single box module num. If the calibration carry out at the scene and the screen have bordures that couldn't be photographed, check Bordure. If we select Correct—Luminance before, check Luminance adjust Chroma so that we could adjust Chroma distribution.
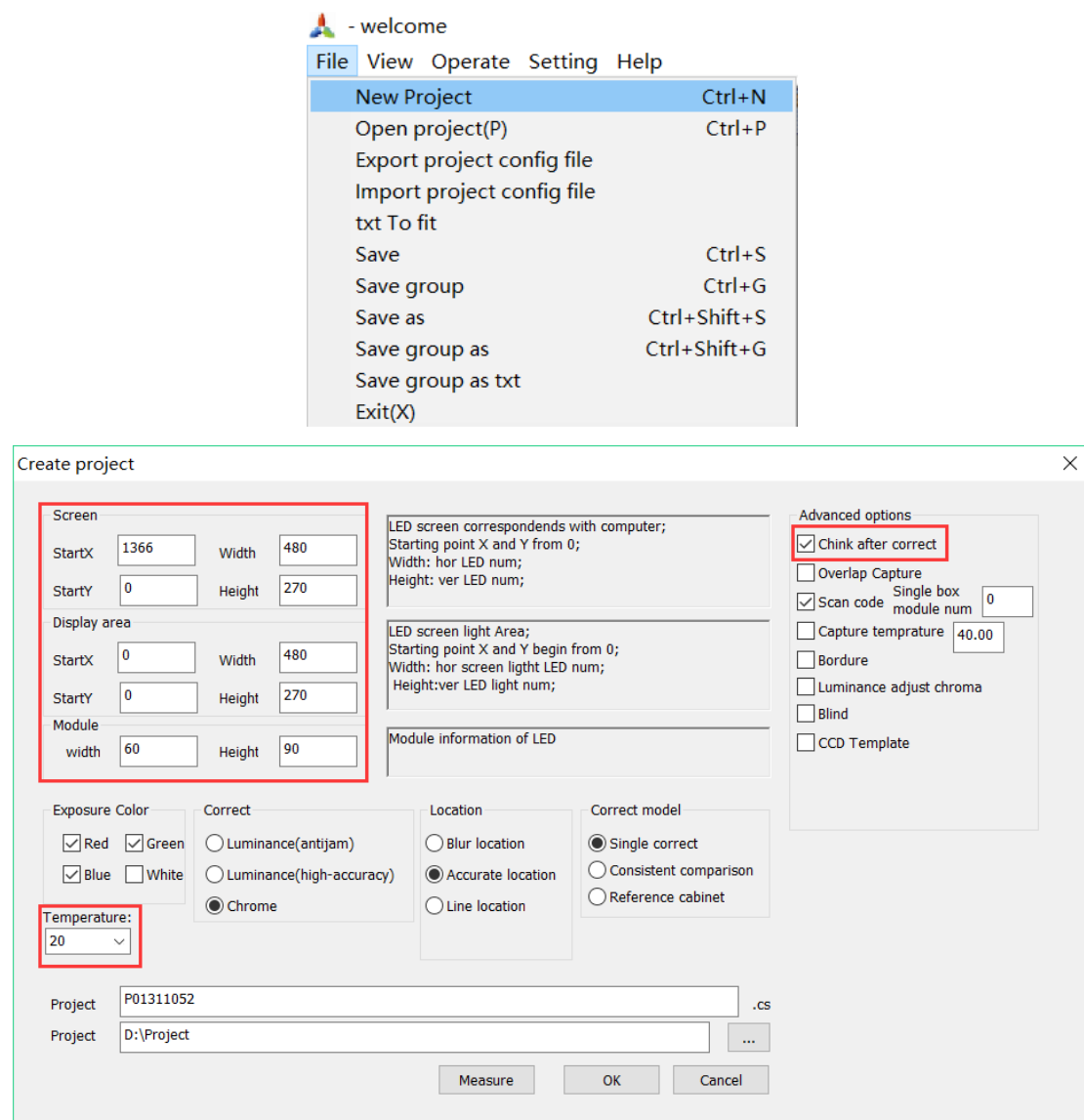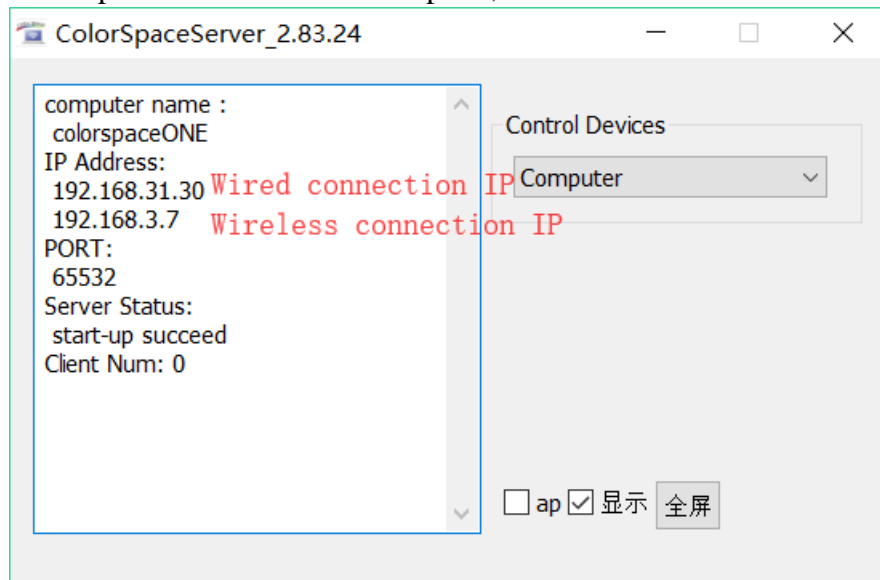


Click on "OK", ColorSpace restart automatically,
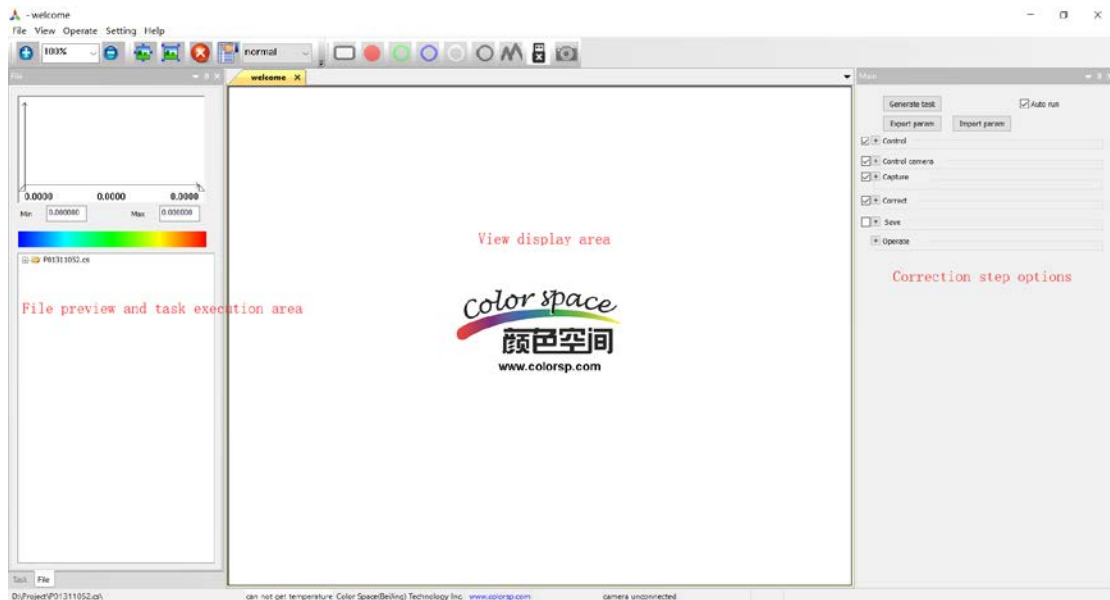
5. Main—Control—Network—Connect

Open ColorSpaceServer at Server computer,

If ColorSpaceServer and ColorSpace run at the same computer, there is only a wireless connection IP; if ColorSpaceServer and ColorSpace run at two different computers, these two different computers should be connected by a network cable or connected in the same wireless network, a wired connection IP when connected by a network cable and a wireless connection IP when connected in the same wireless network.

In ColorSpace on the Client computer, select or enter the wireless connection IP or the wired connection IP at main—Control—Network—IP, click on "Connect", then we can control the screen. Try to change Display color and Interval Step to see whether it changes correctly on the screen.
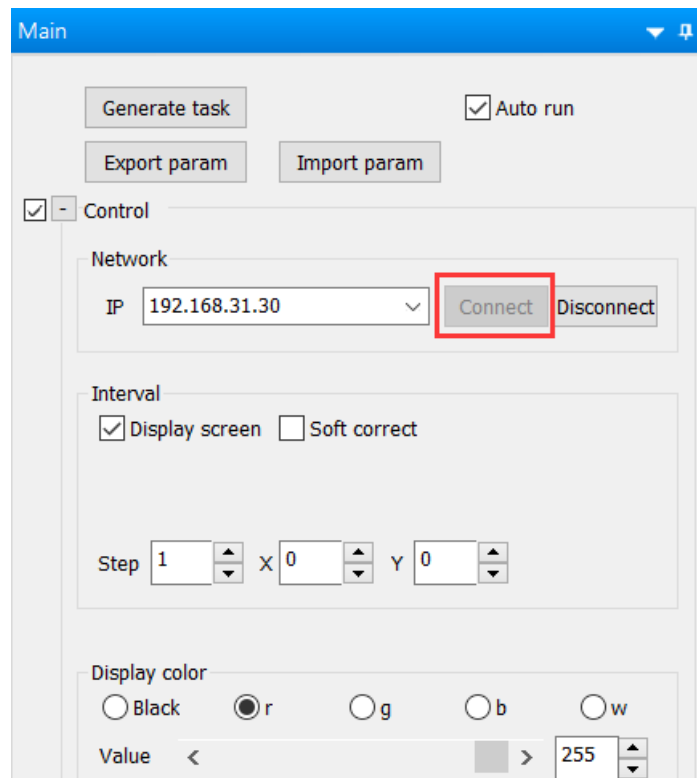
6. Main—Control camera—Connect

Connect the camera to the power supply, connect the camera with the Client computer by a USB cable. After the light on the back of the camera shows green, click on Main—Control camera—Connect, a warning dialog box would pop up, if the light on the back of the camera still shows green, click on "OK"，   then we can control the camera; if the light shows yellow, click on "Cancel", remove the camera from the power supply, repeat this step.
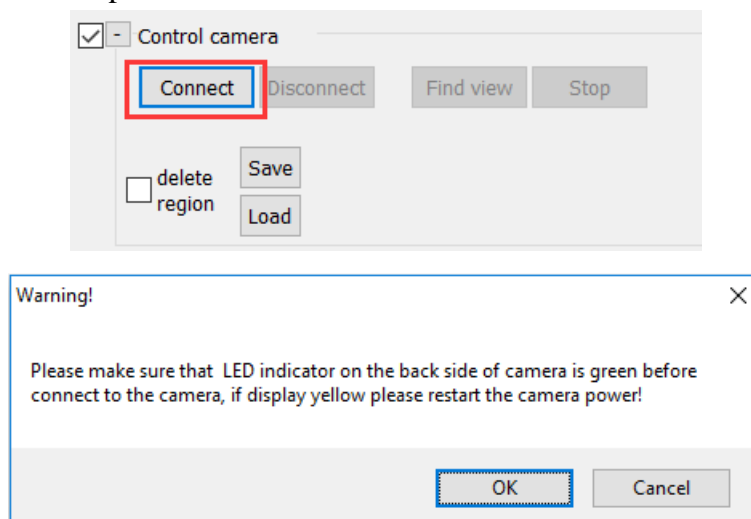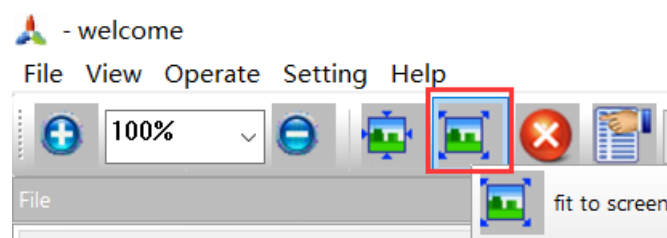
7. Main—Control camera—Find view, adjust the position of the tripod, the three knobs and the zoom ring

Click on Main—Control camera—Find view,
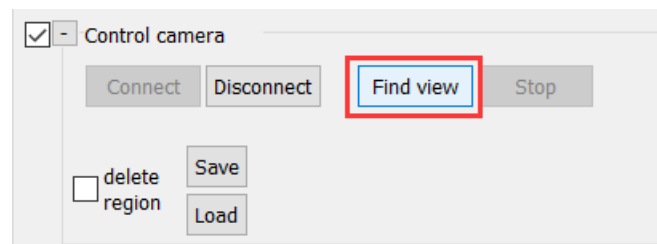
After View display area shows the image photographed by the camera, click on "fit to screen" in the upper left, then we could see the whole image photographed by the camera.


If the entire screen cannot be caught completely by the camera, we should increase the distance between the camera and the screen. If the image of the screen isn't situated in the middle of that photographed by the camera, we should rotate the three knobs to situate the image of the screen in the middle of that photographed by the camera.

In order that the image of the screen occupy a bigger area of the CCD photoreceptor as possible, i.e. image photographed by the camera, do the following operations: if the lens is fixed focus lens, we should reduce the distance between the camera and the screen properly; if the lens could zoom, we could rotate the zoom ring properly. At the same time, the entire screen could still be caught completely by the camera and the image of the screen is still situated in the middle of that photographed by the camera.

8. Main—Control camera—delete region, set up delete regions to eliminate interferences

Jamming light source and reflection of surroundings of the screen would influence the image of the screen so that the location would make mistakes. We should eliminate jamming light source and reflection of surroundings, if couldn't eliminate completely, we should delete those affected areas. When we are in "normal" mode, the mouse is in the shape of a arrowhead at View display area; when we check "Main—Control camera—delete region", we are in "del area" mode, the mouse becomes in the shape of decussation at View display area, then we could delete some areas.
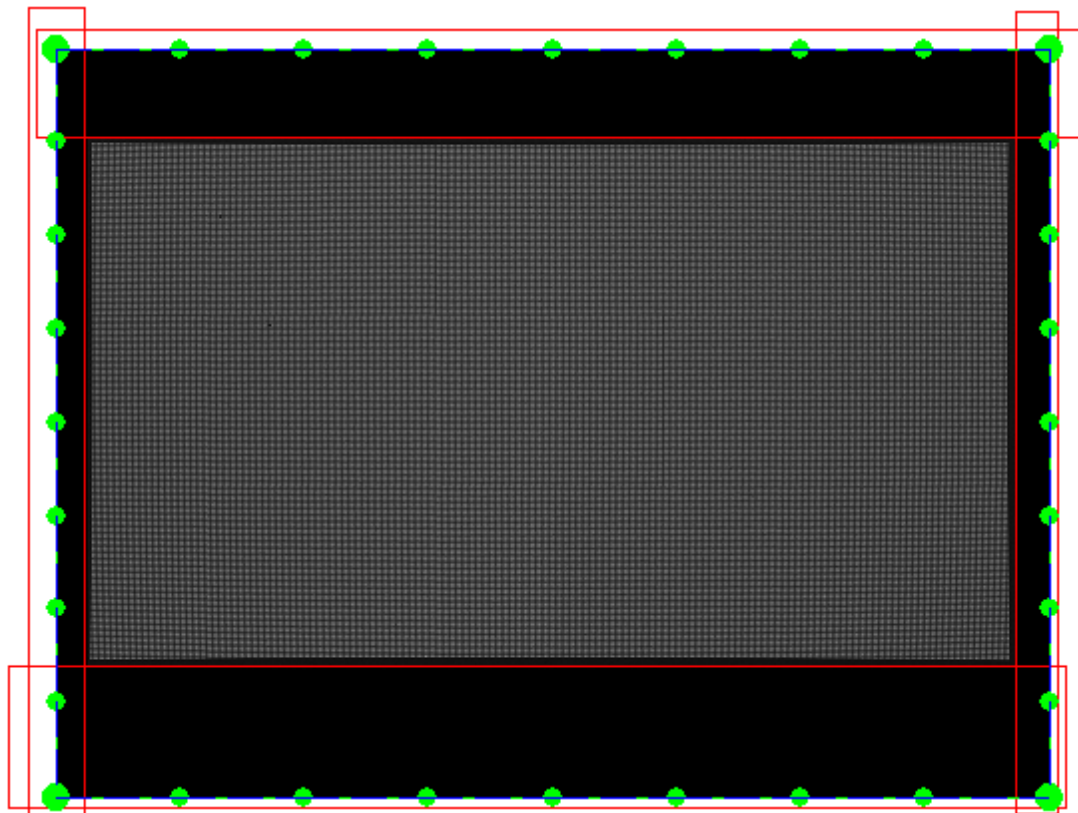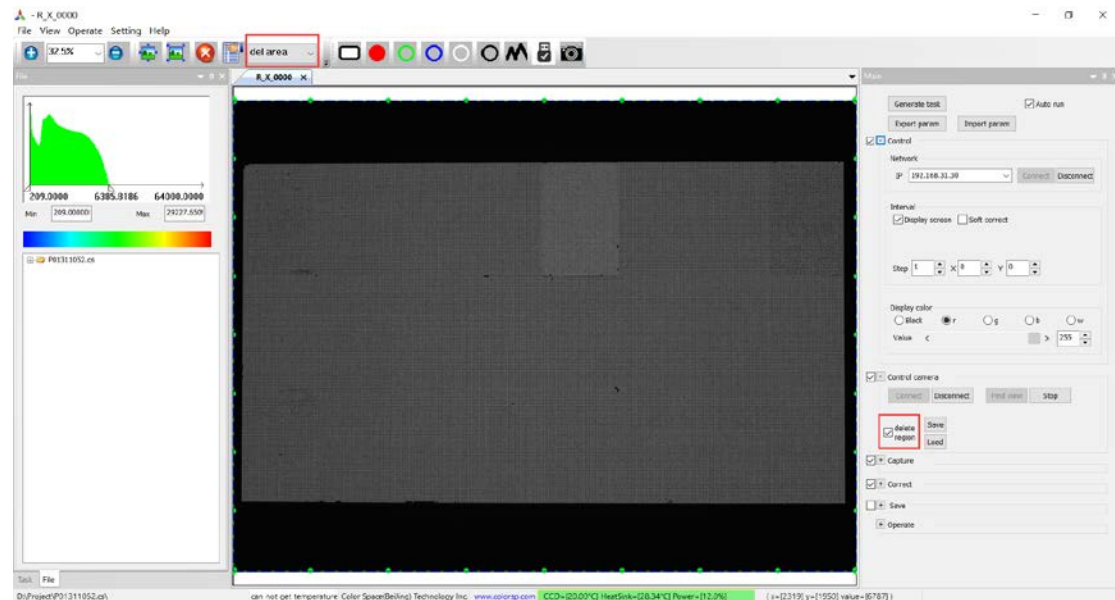
    We could delete some areas by drawing red rectangles or adjusting the green border. Only when we are in "del area" mode, the mouse is in the shape of decussation, we could draw red rectangles, if we don't check "delete area", red rectangles or green border don't appear, it works as normal; if we check "delete area", red rectangles and green border appear, brightness of areas in the red rectangles and out of the green border will be 0. If we eliminate all too bright jamming light sources, brightness of the image of the screen will be higher than before. If we draw a red rectangle by mistake that the image of the screen is involved in, we could click the right mouse button on the area in the red rectangle so as to eliminate the red rectangle. After deleting areas, we should

enlarge the image at View display area, determine whether we have deleted edge area of the screen by mistake.

9. Input an appropriate number in Main—Control—Interval—Step

If the resolution of the screen is pretty big, we could set a proper interval so that the image of a LED occupy an area big enough of CCD, as a result, the data obtained could be more accurate.

If the camera is PM20, the biggest resolution of the screen that could be photographed accurately is 420*300, horizontal LED number and vertical LED number of the screen should be smaller than 420*interval step and 300*interval step respectively. For example, horizontal LED number and vertical LED number of a screen is 480*270, the interval step should be 2.

10. Adjust the focus ring, Main—Capture—LED pixel number bigger than 45

Enlarge the image in the View display area so that we could see clearly pixels of the CCD. Adjust the focus ring of the camera to distinguish images of different LED. Click on Main—Capture—LED pixel num, if LED pixel num is smaller than 45, adjust the focus ring to blur out images of LED so that LED pixel num could be bigger than 45, at the same time, images of different LED could be still distinguished clearly; if LED pixel num is bigger than 45, there's no need to adjust the focus ring. Display color is red, green and blue respectively, LED pixel num should be all bigger than 45. If we couldn't make LED pixel num bigger than 45 when images of different LED are distinguished clearly, interval step add 1.
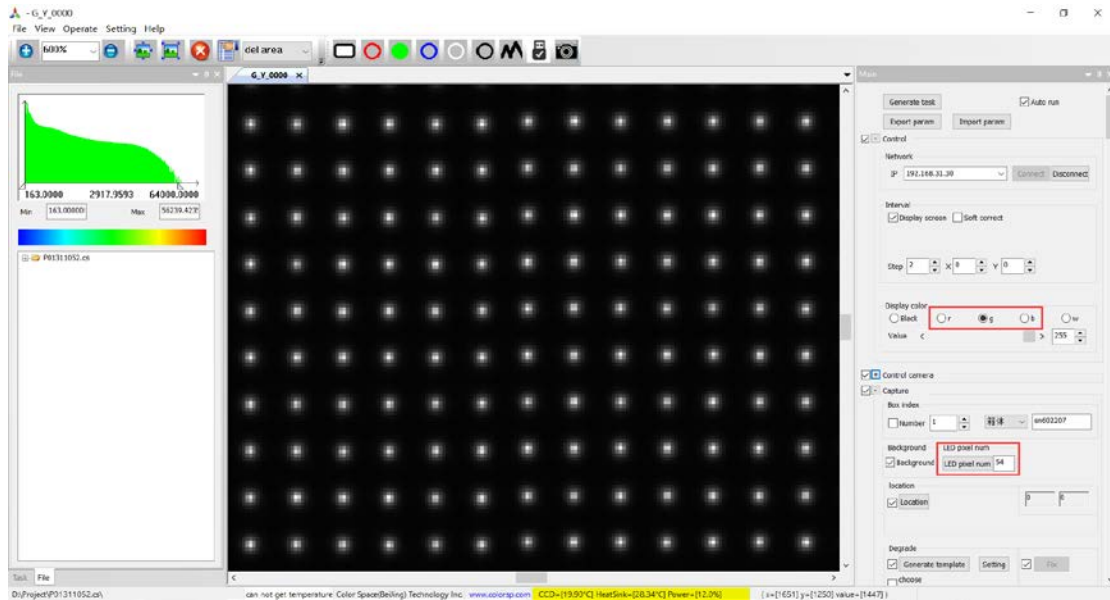
Notes: why should LED pixel num be bigger than 45? When LED pixel num is smaller than 45, images of LED are small and occupy an area too small of CCD, the brightest ray of LED might enter gaps between pixels of CCD so that the data obtained isn't accurate enough, in this condition, brightness of these LED would be considered lower than their real brightness, after calibration, their brightness would be higher than others. As a result, brightness of LED vary regularly, which is called moiré pattern. If LED pixel num is bigger than 45, images of LED are blurry enough and big enough, brightness of a pretty big area is almost the same so that the data obtained would be more accurate. Moiré pattern is as follows,

11. Regulate filter and aperture of the camera, Main—Control—Display color—Value, Max of Chroma information histogram of green between 50000 and 55000

Brightness of one color among the three display colors is biggest, green generally, we illustrate at the condition that brightness of green is biggest. When display color is green, max of the Chroma information histogram on upper left should be between 50

000 and 55 000. Chroma information histogram is as follows,
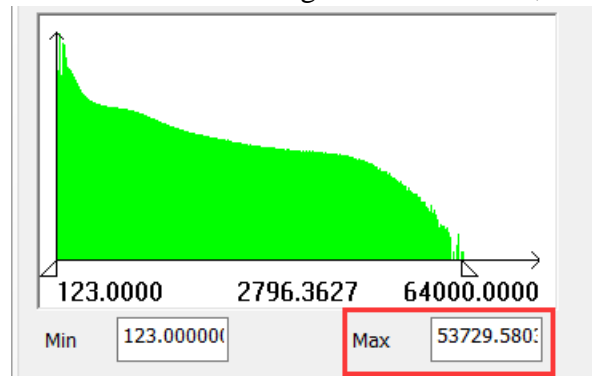

Click on Main—Control—Display color—g, set Value 255, rotate aperture of the camera to be smallest, if max of the Chroma information histogram isn't between 50 000 and 55 000, do as follows:

If max of the Chroma information histogram is bigger than 55 000, add a filter on lens of the camera, rotate aperture of the camera to be smaller, reduce Main—Control—Display color—Value, Value shouldn't be lower than 128 at best; otherwise, take off a filter from lens of the camera, rotate aperture of the camera to be bigger, increase Main—Control—Display color—Value.

12. Check location results respectively for red, green and blue, enter the biggest LED pixel number

Click on Main—Control camera—Stop, the camera stops finding view, View display area displays the image that is photographed at last. Click on Main—Capture—location, two text boxes behind show horizontal and vertical LED number that are lightened, View display area display location view, images of LED are framed by regular grids, which is as follows,
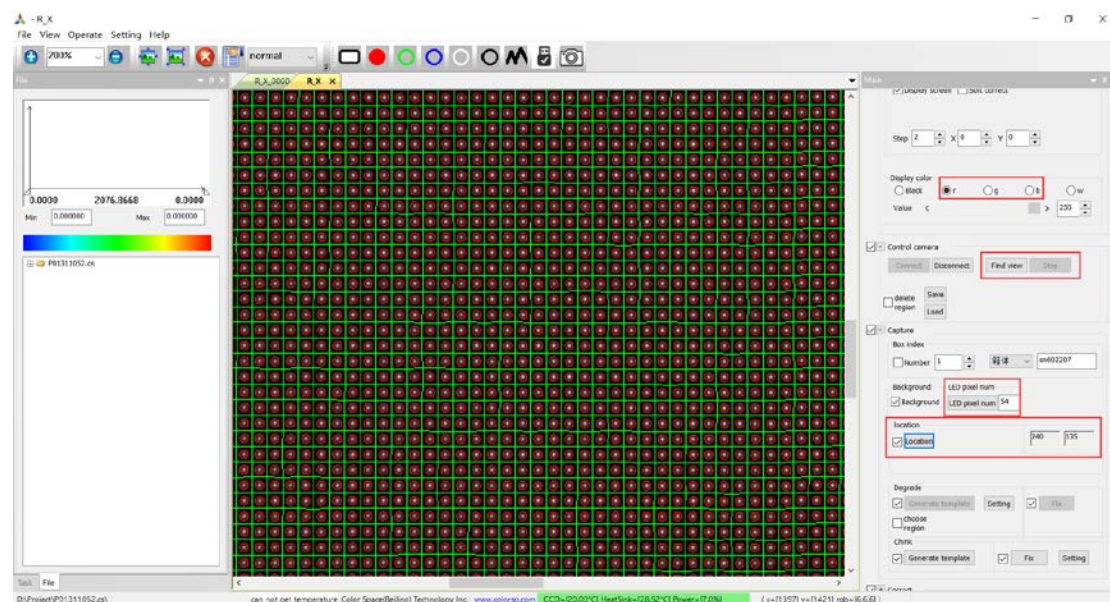
If numbers shown in the two text boxes don't match horizontal or vertical LED

number that are lightened or images of LED aren't framed by regular grids, location makes mistakes. The reason may be existence of jamming light source, reflection of surroundings of the screen or too big distance between images of LED. For the first two questions, we should eliminate jamming light source and reflection of surroundings of the screen manually or set up delete regions to eliminate interferences. For the third reason, we could reduce interval step properly or adjust the focus ring so as to blur out images of LED and increase LED pixel number.

When display color is red, green and blue respectively, click on Control camera—Find view, after View display area shows R_X, G_Y and B_Z respectively, click on Capture—LED pixel num, click on Control camera—stop, click on Capture—Location, determine whether location result is correct, if location makes mistakes, we could solve this by the above methods. Compare LED pixel number for red, green and blue respectively, enter the maximum among these three numbers in the text box on the right of LED pixel num.

Attention: if we do Line location, operations of this step don't carry out.

13. Main—Generate task, pay attention to location results

Enter Gamma in Save—simulation. See the state of the camera, after the temperature of CCD arrive at which we select at the beginning, check Auto run, click on Main—Generate task, calibration process carry out automatically as follows,
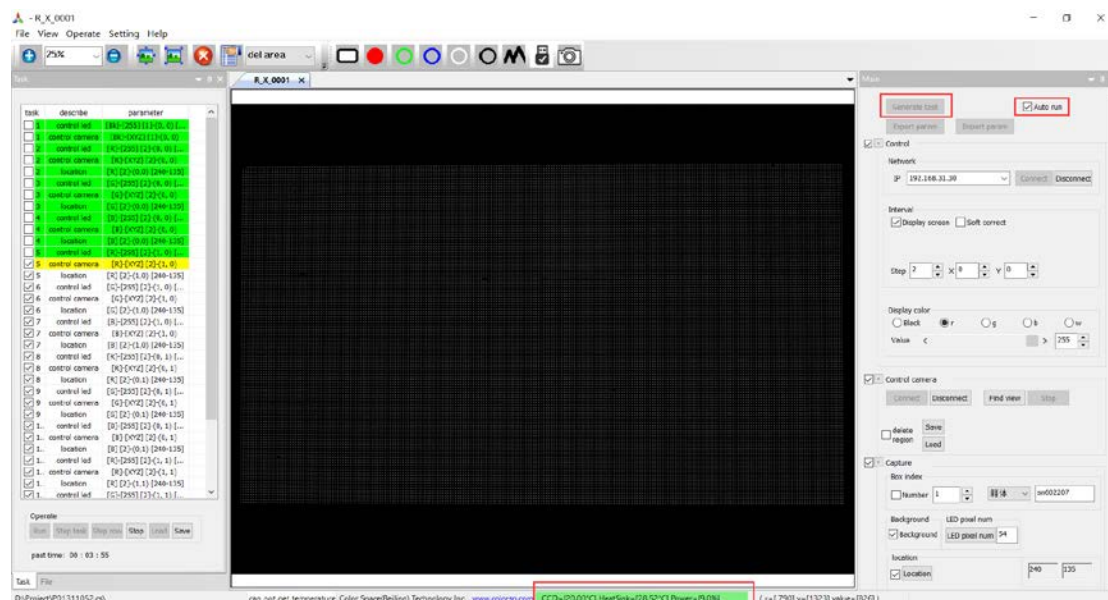
If a step doesn't carry out correctly, its color would turn red, which is an error report. During the calibration process, we should pay attention to error report during the calibration process and location results all the time. If there's an error report or we notice that location makes mistakes, we should click on Operate—Stop in task execution area immediately. After the calibration process stop completely, we should carry out these wrong steps once again, check the whole wrong step including control led, control camera and location, click on Operate—Run. For example, task 11 location makes mistakes, we should carry out the whole 11 step task once again. If there's still

an error report or we still notice that location makes mistakes, we should recheck existence of jamming light source, reflection of surroundings of the screen or too big distance between images of LED, we could solve these problems by methods in last step; if reasons aren't those above, click on Setting—Display advance, check Capture—Location—Float threshold or Fix blind.

If the reason is that a part of the screen is hidden or a large quantity of LED are blind (a few blind LED don't influence the calibration), check Capture—Location—Fix blind. When location carry out, the data of these blind LED will be added.
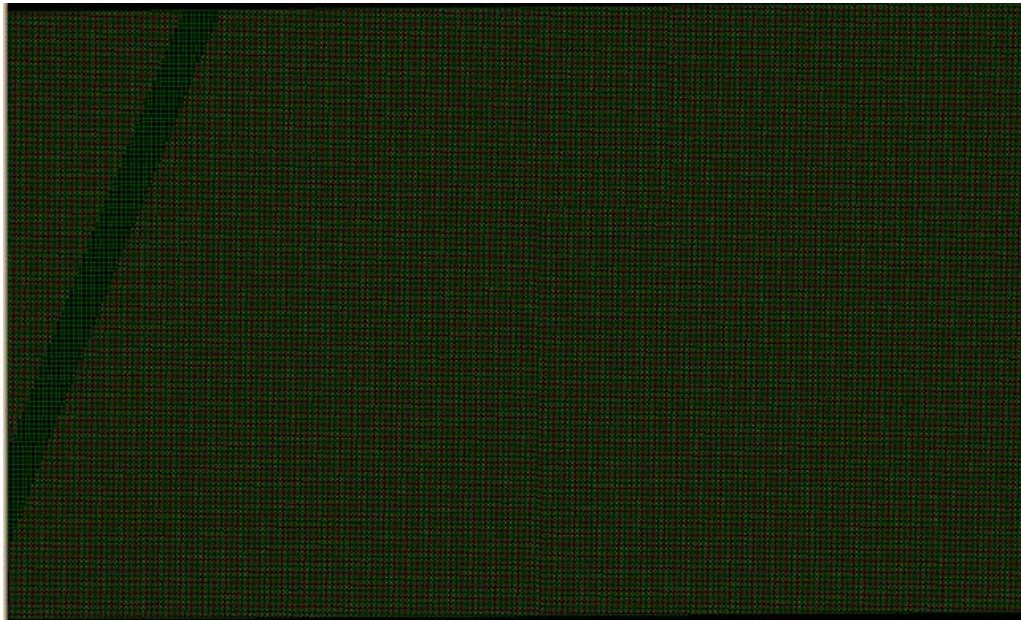
The greener area is the part hidden of the screen.

If brightness of the screen vary greatly (the highest brightness is more than 40% higher than the lowest brightness), the area with a lower brightness will be considered that there's no LED. Check Capture—location—Float threshold, location carry out basing on brightness of different areas. For the area with a lower brightness, location carry out basing on a right brightness value of this area.

The calibration process is accomplished as follows,
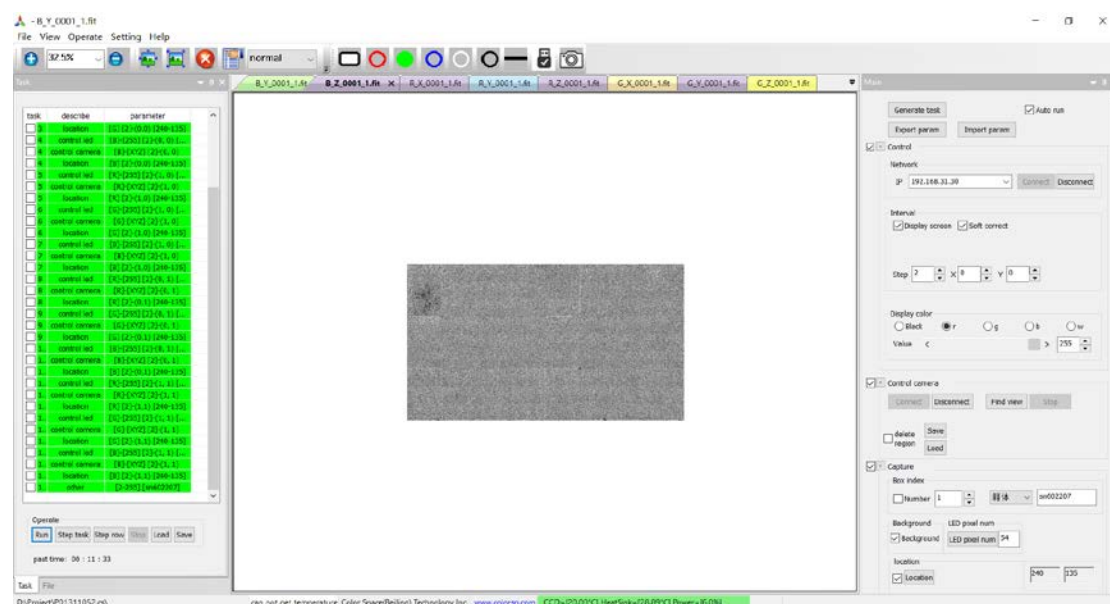
14. Main—Control—Interval—Soft correct or Main—Save—simulation—Simulation

Select Control Device in Save—simulation, click on Send.

After the loading, we could see the result of calibration. If we have selected Control Device and checked Save before the last m. step, the screen would show the result of the calibration. Set Control—Interval—Step to be 1, Display color—Value to be 255, change Display Color, especially white, we could see with and without calibration if we click on Soft correct. If we are satisfied with the result of calibration, do the following step.

15. Main—Save—file correct—Format, Generate

In Save—file correct—Format, select the format of the screen. If the calibration file could be download entirely, we could click on file correct—Generate directly. If the calibration data should be split so as to be downloaded into the screen, click on Set layout.
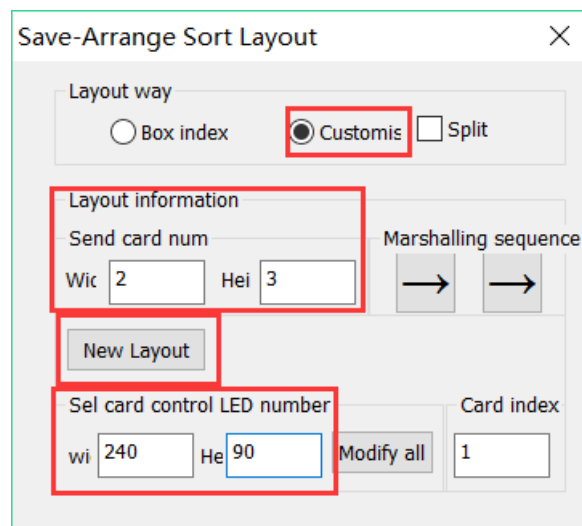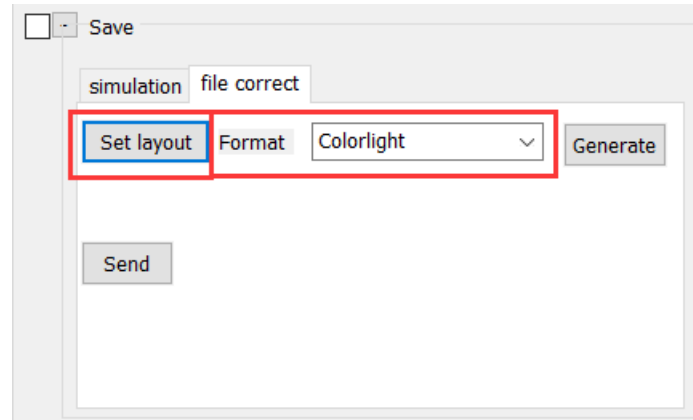
In the window of Save-Arrange Sort Layout, click on Customise, enter horizontal send card number in Send card num—Width, vertical send card number in Send card num—Height, select Marshalling sequence which should be the same with the arrangement of send card, enter the resolution of the cabinet in sel card control LED number, click on New Layout, we will get a following table.

If some cabinets' size is different from others, enter the cabinet size in sel card control LED number, left double click on the cabinet with this size in the table.

Click on Save—file correct—Generate. The calibration file generated is in save file folder of present project. The following shows the condition that we don't need to split the calibration data.
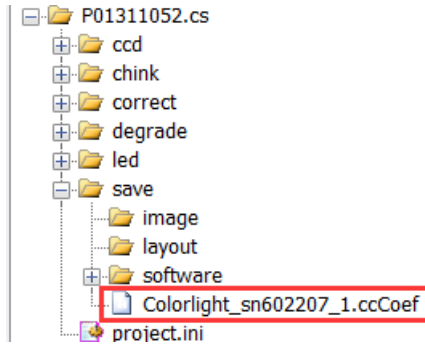
Click on Save—file correct—Send, the calibration file generated would be sent to the save file folder of the path where ColorSpaceServer is.

Notes: what determine the last number of the calibration filename (i.e. 1 of Colorlight_sn602207_1.ccCoef)?

If we have created a New Layout, the number would be the same with the card index.
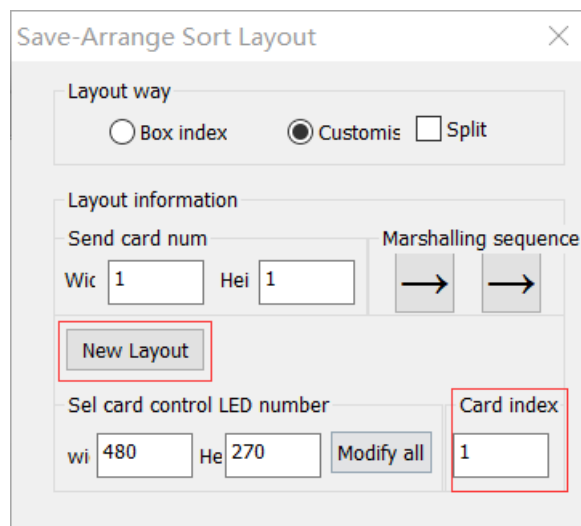
If we haven't created a New Layout, there are LED pictures at View display area when we click on Save—file correct—Generate, the number would be the same with the first non-zero number of these LED pictures' name.
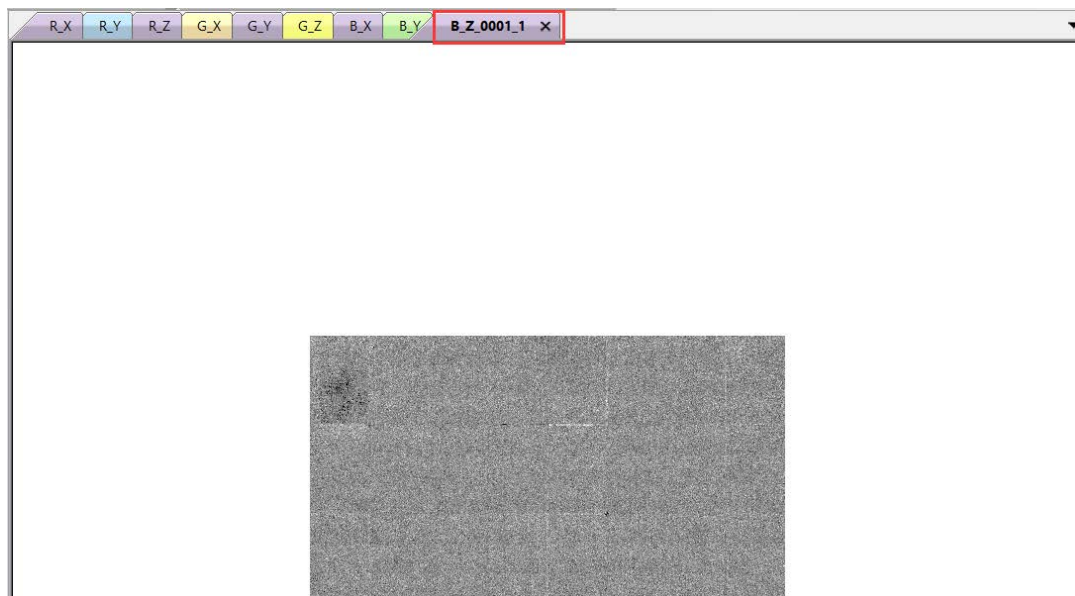
If we haven't created a New Layout, there aren't LED pictures at View display area when we click on Save—file correct—Generate, the number would be the same with Capture—Box index—Number.

III. Manual operations

1. Manual calibration operation steps

The calibration process could be accomplished manually once we have got original pictures of the screen. When tasks generated are finished, we get original pictures of the screen in led—1 file folder.
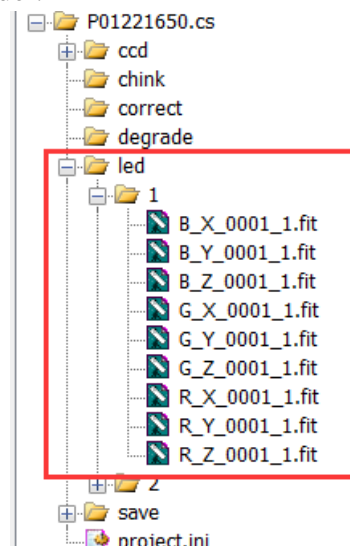
Right click on a fit file in led—1, select Open group. Click on Main—Capture—Degrade—Setting, enter or select these settings,
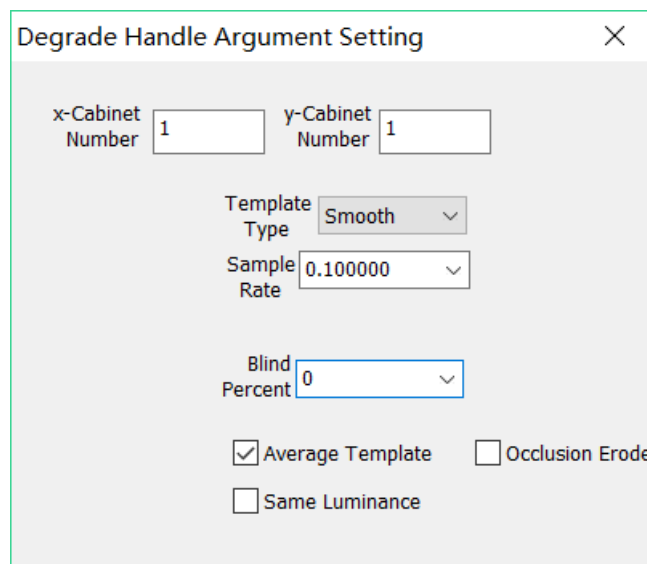
Attention: Set Interval—Step the same with that when we photographed the screen.

Click on Degrade—Generate template, click on Degrade—Fix. After having fixed degrade, pictures generated will be saved in degrade file folder.

Click on Chink—Setting, select Common in Fix Way.

① Check Auto Calc Dynamic, Network and Camera should be connected.

② Don't check Auto Calc Dynamic, enter a proper number in Save—simulation—Repair. See chinks on pictures generated after being fixed chink, if their

brightness is not similar to that on the screen or if simulation result for chinks is bad, the number in Save—simulation—Repair isn't proper. See whether there's G_Y.fit in ccd—1 file folder. Yes, double click to open it; no, Network and Camera should be connected.

Click on Generate template, Click on Fix. After being fixed chink, pictures generated will be saved in chink file folder.

Enter or select Color Gamut, Sigma and Color temperature in Main—Save, click on Calc target, select Correct way, click on correct.

Select Computer as Control Device in Save—simulation, click on send. After the loading, we can see the result of calibration.
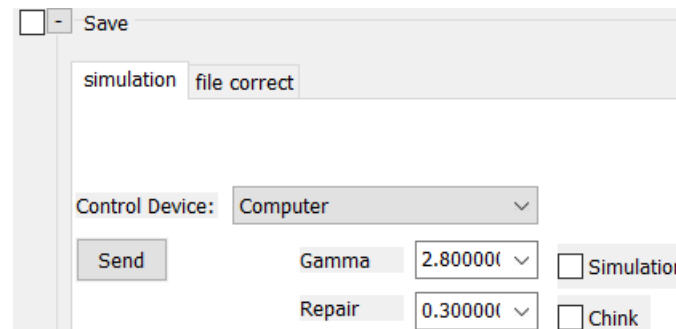

## 2. Eliminate influence of ambient light

When the calibration carry out at the scene, ambient light would be more uncontrollable. If Interval—Step isn't 1, average brightness of pictures of the same type should be the same. For example, Interval—Step is 2, G_Y_0000, G_Y_0001, G_Y_0100 and G_Y_0101 should have the same average brightness. If the calibration process is influenced by ambient light, average brightness would be different. For this reason, the result of calibration would be unsatisfied.

Right click on a fit file in led—1 file folder, select Open group. Enlarge a picture in View display area. If points with a higher brightness or with a lower brightness are at the same interval with Interval—Step, we need to eliminate influences of ambient light by following operations.

Right click on toolbar, click on Graphics so as to open Graphics view.
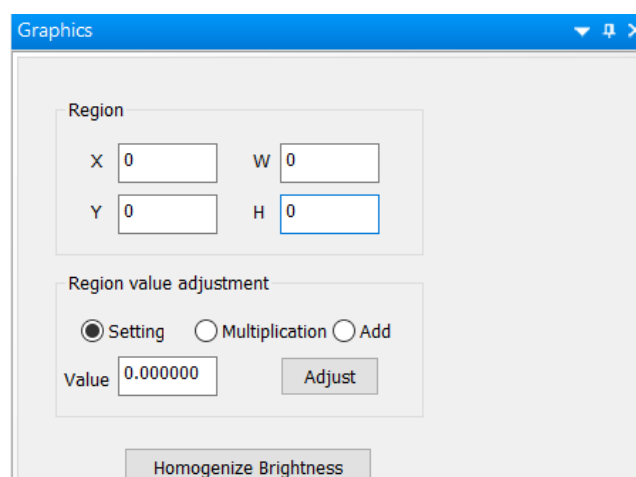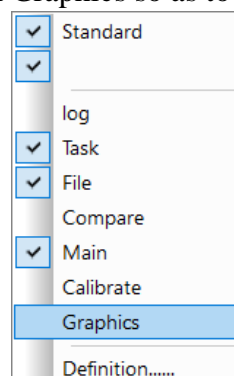
Click on Homogenize Brightness, select all files in led—2(this number is Interval—Step) file folder, click on Open. Pictures obtained after adjustment will be saved in led—2—Multi file folder.
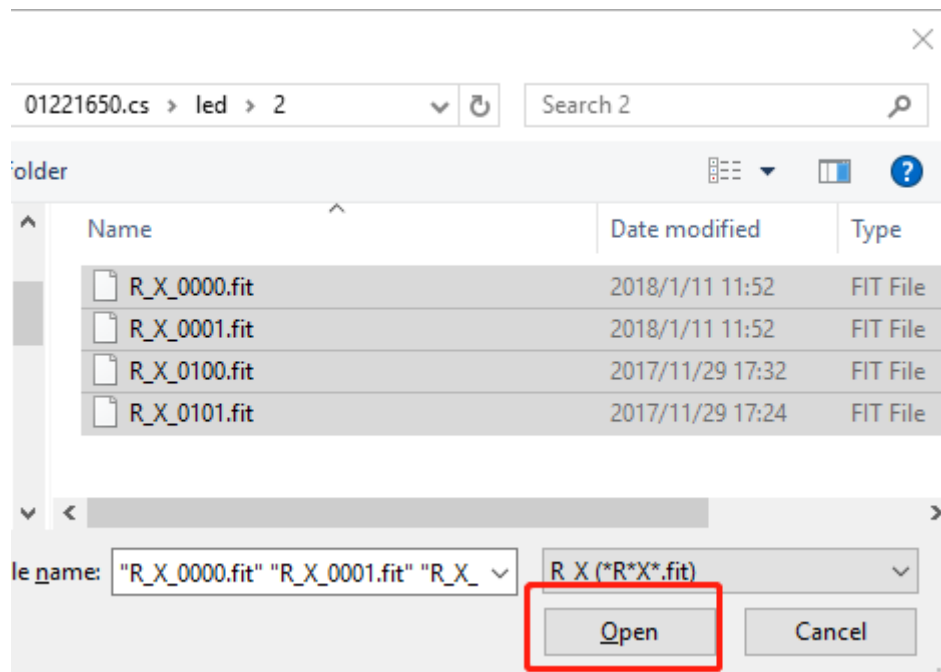

Click on Setting—Display advance. In Main—Operate—Merge, select Cross merge, enter Line File Num that should be Interval—Step, click on Group merge, select all files in led—2—Multi file folder, click on Open. Pictures obtained after being merged will be saved in led—2—Multi—merge file folder. Manual calibration operation should carry out by using these pictures.
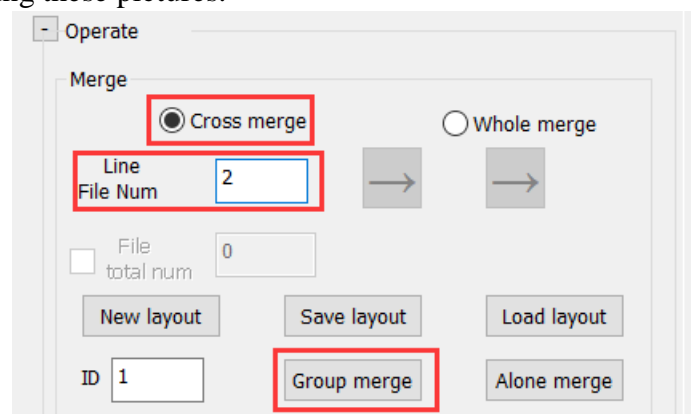
3. Fix degrade of a region

If there's a stain in CCD of the camera, the data obtained would be inaccurate. We could eliminate influences of the stain by fixing degrade of the region where the stain is.

Attention: Set Interval—Step the same with that when we photographed the screen.
Right click on a fit file in led—1, select Open group,
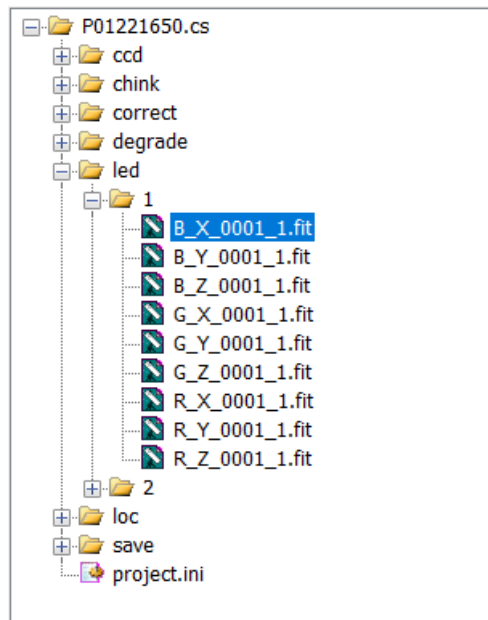
Don't check Main—Capture—Degrade—choose region. Click on Degrade—Setting, enter x-Cabinet Number and y-Cabinet Number, select Template Type and Blind Percent, check Average Template, Occlusion Erode or Same Luminance. Click on Degrade—Generate template, click on Degrade—Fix, then we accomplish fixing degrade of the whole picture.

Check Main—Capture—Degrade—choose region, then we could draw a red rectangle in the picture. We will fix degrade of the region in the red rectangle.

Click on Degrade—Setting, enter x-Cabinet Number and y-Cabinet Number, select Template Type and Blind Percent, check Average Template. Click on Degrade—Generate template, click on Degrade—Fix, then we accomplish fixing degrade of a region. If we are unsatisfied with the result, click on Degrade—Fix again or redraw another red rectangle, click on Generate template, click on Fix.

Notes: We can delete the red rectangle by right click the area in the red rectangle.

Then we could carry out the following operations, for example, fix chink, correct and save etc.

4. Calibration to a certain percentage of original brightness

Brightness after calibration could be a certain percentage of original brightness by following operations.

Select Percent in Main—Correct—Sigma, enter the percentage in the first box of RGB Target data. Other operations are the same with Ⅱ. Operation procedure of software.

5. Calibration a screen divided into several regions

If the camera couldn't photograph the whole screen, we need to divide the screen into several parts. At every turn, we lighten one part, the camera photograph this part, then we merge pictures we got, carry out manual calibration operation to pictures merged and generate calibration data file finally. The whole process include photographing, merging, calibration and generating calibration data file these four steps.

Photograph

Divide the screen into several parts, these parts have better to be congruent. If these parts are in n row, there are n parts whose size is different, smaller and at right end of the screen. At every turn, we lighten one part, the camera photograph this part.

Attention: If cabinets aren't the same batch and have obvious differences in brightness or Chroma. When we divide the screen into several parts, a part should include cabinets of different batches so that differences in brightness or Chroma could be photographed.

Attention: At every turn, distance between the camera and the screen should be the same. Visual angle or height of the camera can't change, we can't adjust knobs or height of the tripod, nor zoom ring or focus ring of the camera. Before we begin photographing the first part, we should mark the position of the camera, lighten the second part. Note the displacement from the center of the first part to that of the second part as specified displacement, the camera move to a new place with specified displacement. At the new place, the camera could photograph the whole second part. Do the same for the following parts.

1、 Set up sender or video processor so that the screen corresponds with the controlling computer point by point, Open ColorSpaceServer on the controlling computer, open ColorSpace on the Client computer. At every turn, we create a new project, Control—Network—Connect, Control camera—Connect, Capture—Box index—Number plus 1.

2、 Control camera—Find view. When we photograph the first part, we can adjust the position, knobs and zoom ring of the camera, can't when photograph following parts.

3、 Set up delete regions to eliminate interferences, especially jamming light source and reflection of surroundings.

4、 Enter an appropriate number in Control—Interval—Step, and this number would be Interval—Step for all parts.

5、 Adjust focus ring of the camera, Capture—LED pixel number should be bigger than 45.

6、 Regulate filter and aperture of the camera, Control—Display color—Value, Max of Chroma information histogram of green should be between 50000 and 55000. If there're differences in brightness among these parts, Max for the brightest part should be between 50000 and 55000. We can't regulate filter and aperture of the camera, Control—Display color—Value for the following parts.

7、Check location results respectively for red, green and blue, enter the biggest LED pixel number. We can't change LED pixel number for the following parts.

8、Click on Capture—Degrade—Setting, select All 1 in Template Type. After the temperature of CCD arrive at which we select at the beginning, check Auto run, click on Main—Generate task. Pay attention to location results.

9、Select Control Device in Save—simulation, click on Send. After the loading, we could see the result of calibration.

When all parts have been photographed, we will get one project for every part.

Merge

Merge pictures in chink file folder of all projects. At every turn, with Capture—Box index—number plus 1, names of pictures in chink file folder of different projects are different, as a result, it's easy to merge. Copy pictures in chink file folder of all projects to a chink file folder.

Enter Line File Number in Main—Operate—Merge, and this number is number of parts in one row. Select directions of the two arrows so that arrangement of pictures is the same with that of parts, click on Group merge.
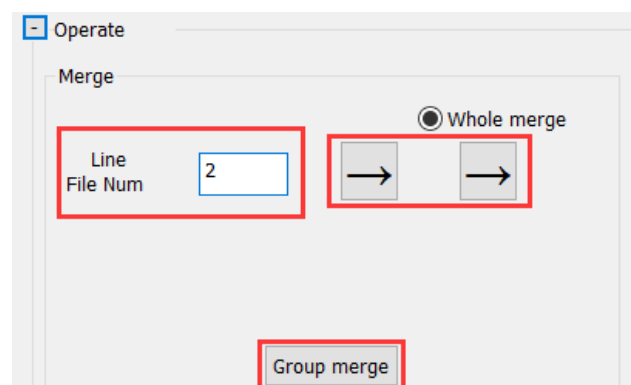
Select all fit file in chink file folder including all pictures we need, click on open.
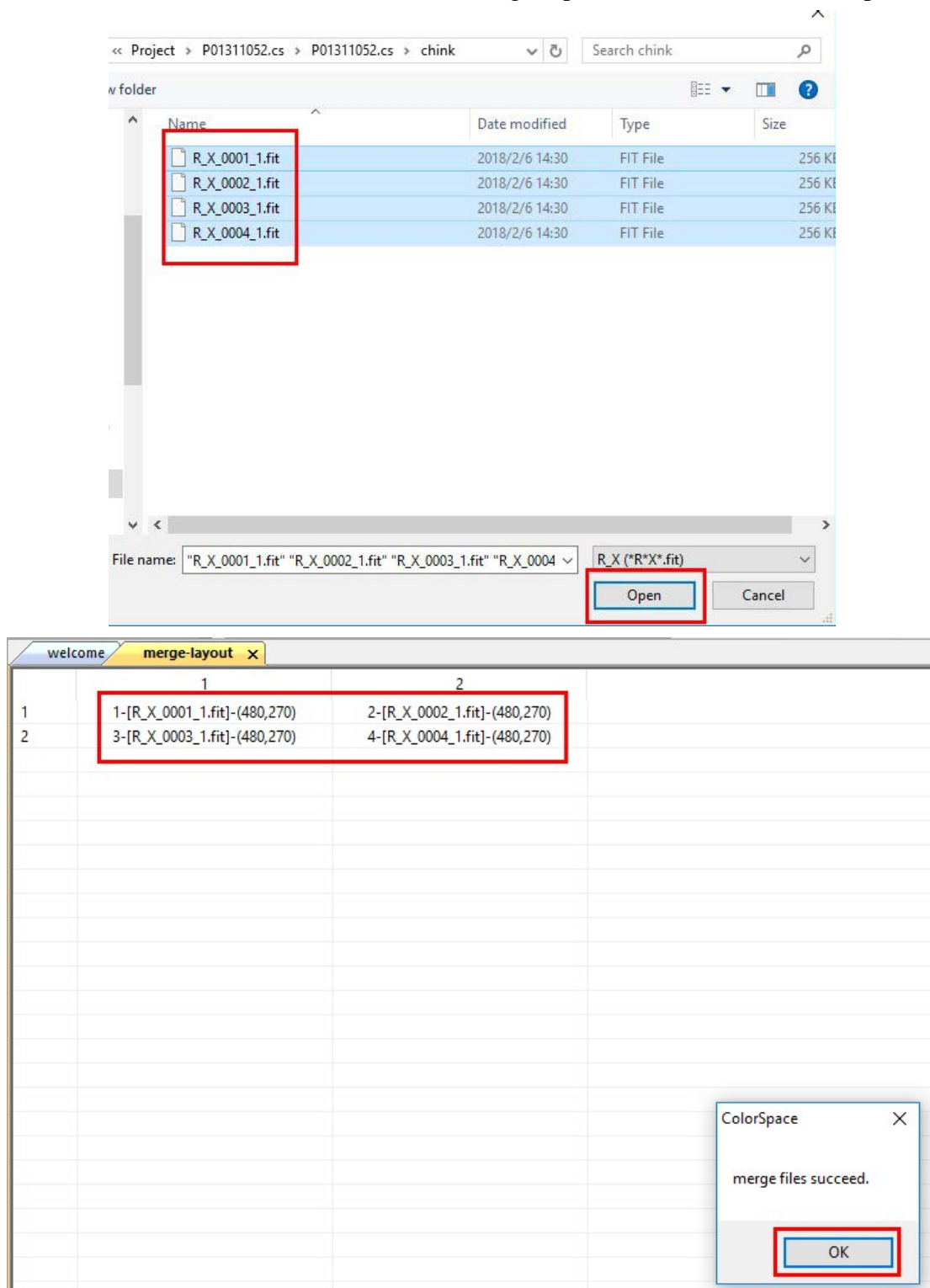
A table would be created in View display area and a <merge files succeed.> prompt box would be popped, click on "OK". See whether arrangement of fit files is the same with that of parts. If not, click on Setting—Display advance, Operate—Merge—ID is the number in front of fit file, right click on another grid then we exchange two fit files in the two grids. ID plus 1 after right click. Right click to exchange fit files until arrangement of fit files is the same with that of parts corresponding. Click on Operate—

Merge—Group merge, pictures will be merged according to arrangement in table.

Pictures merged are saved in chink—merge file folder. Create a new project, Screen—Width/Height should be width/height of the whole screen, click on OK.

Copy pictures merged to led—1 file folder of the new project.

Correct

Right click on one picture in led—1 file folder of the new project in ColorSpace, select Open group. Click on Main—Capture—Degrade—Setting. Select Smooth in Template Type.

If there's no sudden change of brightness in the pictures, enter 1 in x-Cabinet Number and y-Cabinet Number. If there's a sudden change of brightness in the pictures but no sudden change when the screen are lightened. The reason is that angles of photographing are different. Enter appropriate x-Cabinet Number and y-Cabinet Number so that parts with sudden change of brightness are in two different cabinets. For example, cabinets of the screen are in 22 rows and the screen are divided into three parts when photographing, 8 rows, 8 rows and 6 rows respectively. There is sudden change of brightness between the second and the third parts in the pictures but no sudden change when the screen are lightened. The reason is that angles of photographing are different. 11 or 22 for x-Cabinet Number could realize that parts with sudden change of brightness are in two different cabinets.

Don't check Average Template. If the whole screen have the same brightness, check Same Luminance. If cabinets aren't the same batch and have obvious differences in brightness, don't check Same Luminance. If some LED are covered partly by borders, check Occlusion Erode (if we don't check Occlusion Erode, these LED would be considered to be LED with lower brightness, these LED would be lighter than others after calibration).

Attention: Set Interval—Step the same with that when we photographed the screen.
Click on Generate template, click on Fix.
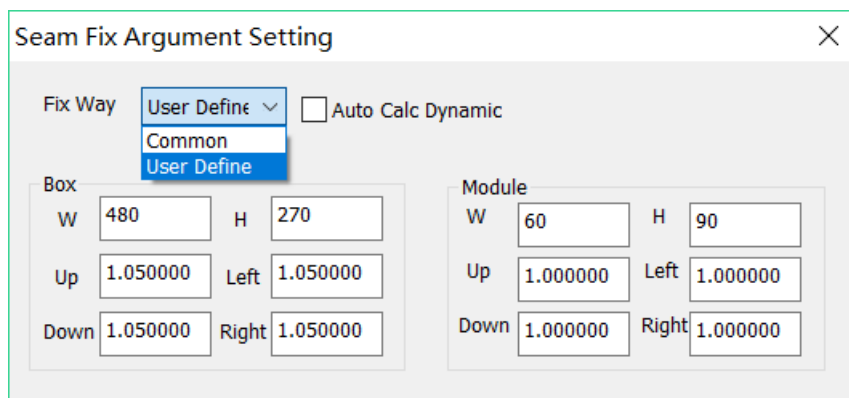
Next, fix chink between different parts. Click on Capture—Chink—Setting, select User Define in Fix Way, enter 1 in Module—Up/Down/Left/Right, enter width/height of parts or bigger parts in Box—W/H, enter proper numbers in Box—Up/Down/Left/Right, click on Chink—Generate template, click on Chink—Fix.

Attention: It's not certain that numbers in Box—Up/Down/Left/Right are proper. See pictures after fixing chink, if brightness or darkness of chinks in pictures is similar to

that on the screen, these numbers are appropriate.

Select a proper number in Correct—Sigma, click on Calc target, click on Correct.

Generate calibration data file

Operations in this step are the same with those in
15. Main—Save—file correct—Format, Generate.

6. Just chink and Auto Calc Dynamic

1、 Click on File—New Project, select Single correct for Correct model, check Chink after correct and Just chink in Advanced options, click on OK.

2、 Click on Control—Network—Connect, enter a proper number that location could carry out correctly in Interval—Step, select g in Display color, set 255 for Value.

3、 Click on Control camera—Connect, after the light on the back of the camera shows green, click on OK in warning window.
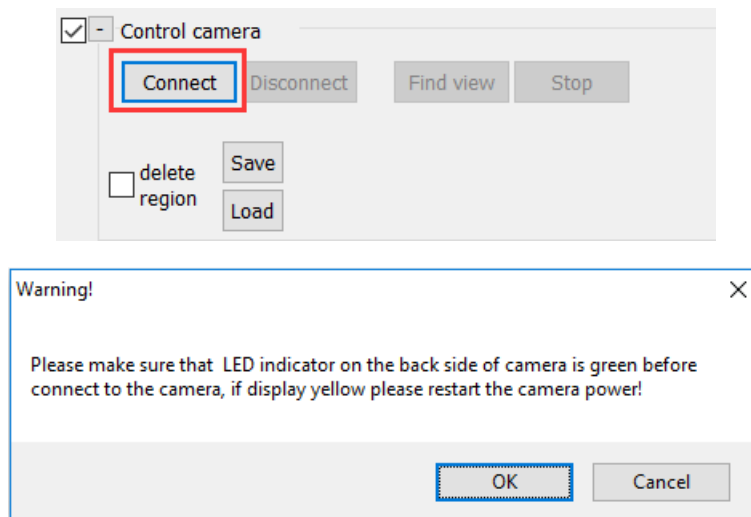
4、 Click on Control camera—Find view.
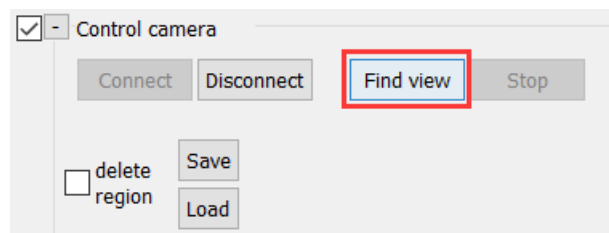
5、 Regulate filter and aperture of the camera, Control—Display color—Value to make Max of Chroma information histogram between 50000 and 55000.
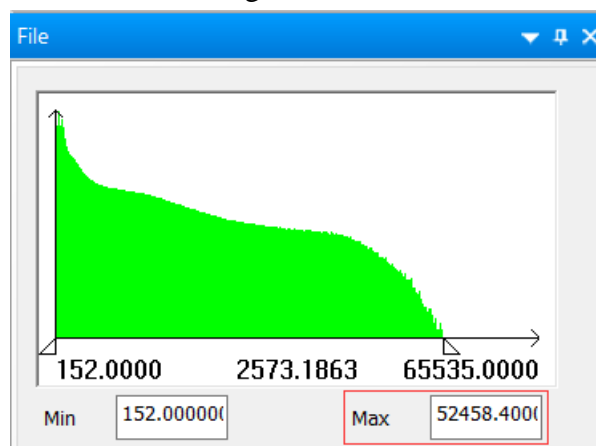
6、 Click on Capture—LED pixel num, LED pixel number should be bigger than 45. If not, adjust the focus ring to blur out images of LED so that LED pixel number could be bigger than 45. At the same time, brightness of the picture will decrease, return to step 5.

7、 Click on Control camera—Stop, click on Capture—Location, check location result.
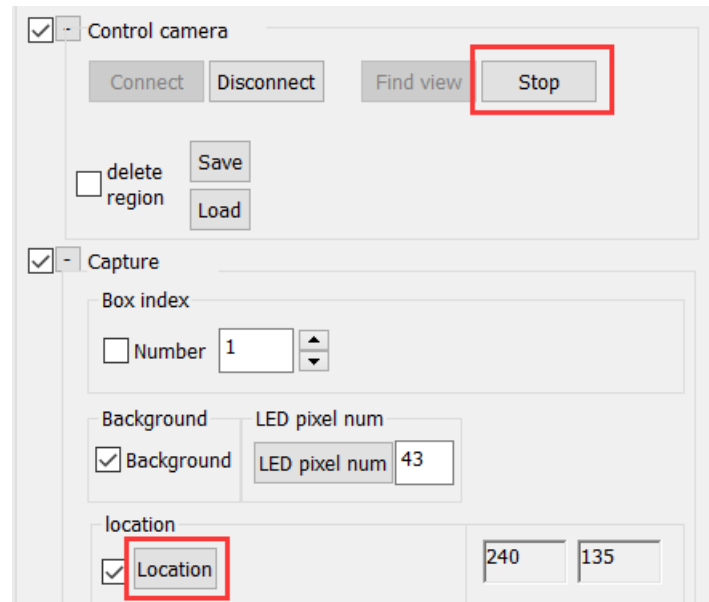
8、 Click on Capture—Chink—Setting, select Common in Fix Way, check Auto Calc Dynamic.
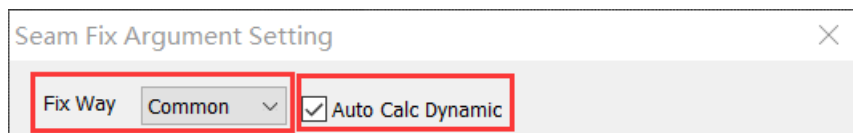
Attention: After tasks generated are accomplished, Auto Calc Dynamic will be not checked. As a result, if we use the same project instead of creating a new project at every turn to calibrate multiple cabinets, we need to check Auto Calc Dynamic at every turn.

9、 Click on Generate task.
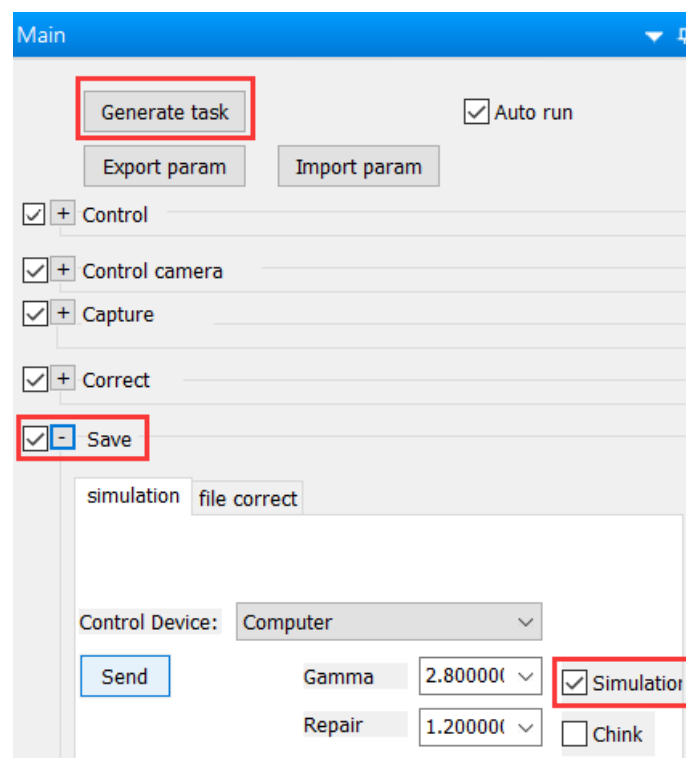
If we have selected Control Device and checked Save before we click on Generate task, after tasks generated are accomplished, the screen would show the result of the calibration. Click on Save—simulation—Simulation, if Simulation is checked, we could see the result of the calibration; if not, the original screen.

7. Merge chink files

Chink files are fit files in chink file folder. If we do Just chink like in the last section, there's only G_Y_0***_1.fit in chink file folder.

1、 Copy all chink files that need to be merged in a chink file folder. If we use the same project to calibrate multiple cabinets, do check Capture—Box index—Number so that Box index—Number would add 1 when we photograph the next cabinet. If not, chink files would be replaced by those newly generated because of their same filenames.

2、 Enter Line File Num in Operate—Merge, which should be the same with horizontal cabinets number. Select directions of the two arrows so that arrangement of fit files is the same with that of cabinets, click on Group merge.
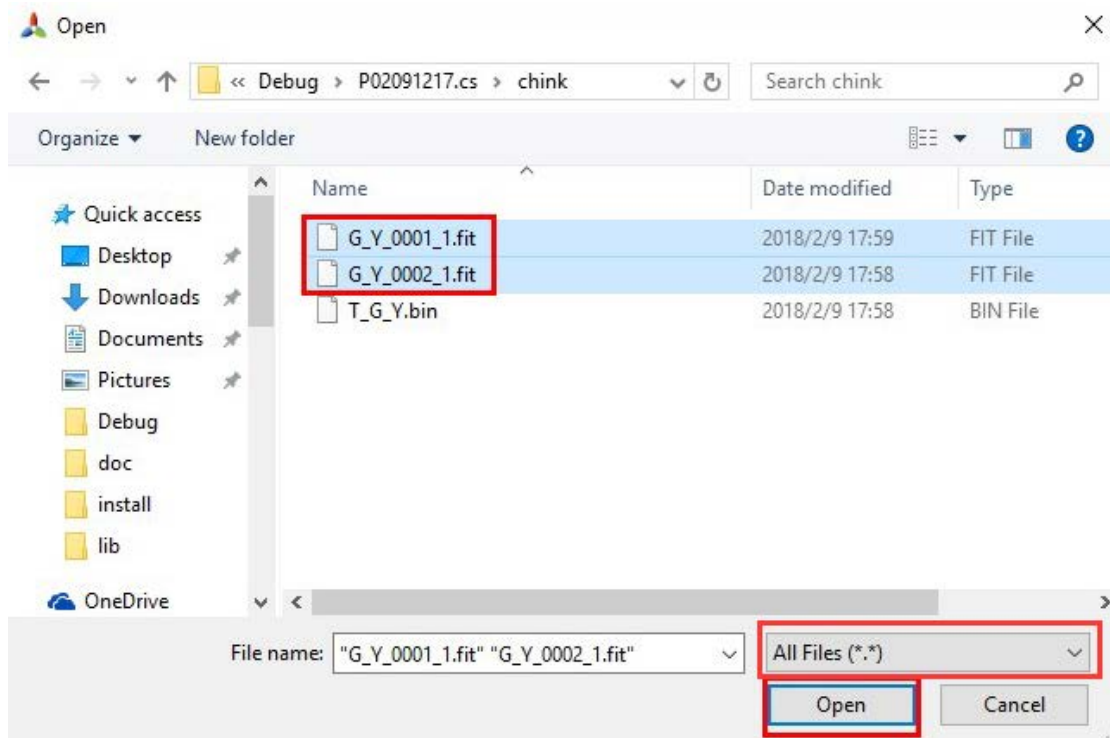
In the file folder containing all chink files, select All Files for format of file, select all chink files, and click on Open.

A merge-layout table would be created in View display area. See whether arrangement of fit files is the same with that of cabinets. If not, click on Setting—Display advance, Operate—Merge—ID is the number in front of fit file, right click on another grid then we exchange two fit files in the two grids. ID plus 1 after right click. Right click to exchange fit files until arrangement of fit files is the same with that of cabinets corresponding. Click on Operate—Merge—Group merge, pictures will be merged according to arrangement in table.

3、 After being fixed chink, pictures generated will be saved in chink—merge file folder, right click and select Open group, click on Main—Correct—Correct.
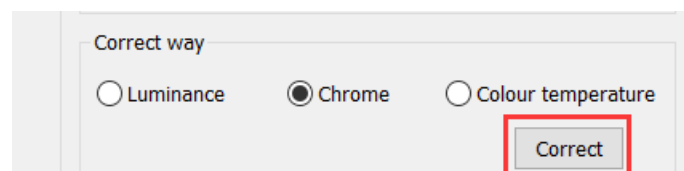
4、 At last, generate calibration data file, whose operations are the same with II. Operation procedure of software 15. Main—Save—file correct—Format, Generate.

IV. Attentions in two different situations

1. Calibration in the factory

(1) Preparation for calibration environment

1) A calibration space of 1-2 meters wide and 10 meters long should be set in the interior of the exhibition room far away from the door;
2) Use a black curtain to distinguish the calibration space from the outside;
3) Cover all around, front and back of the space and the ground with black flannelettes to guarantee that there's no reflection and light from outside;
4) Provide two 200V power outlets for PC and Photometer calibration device, i.e. the camera;
5) Set up a stable test platform fixed on the ground inside the calibration space;
6) Cover the platform with black flannelette, and set brackets to fix cabinet to be calibrated;
7) Black flannelette cannot wrinkle to avoid covering the cabinet;
8) Brackets should ensure that cabinet is perpendicular to the ground and not removable;
9) Ensure that cabinet faces the Photometer calibration device and the Photometer photographs the cabinet vertically;
10) Set tables or chairs outside the calibration space to place PC and sender.
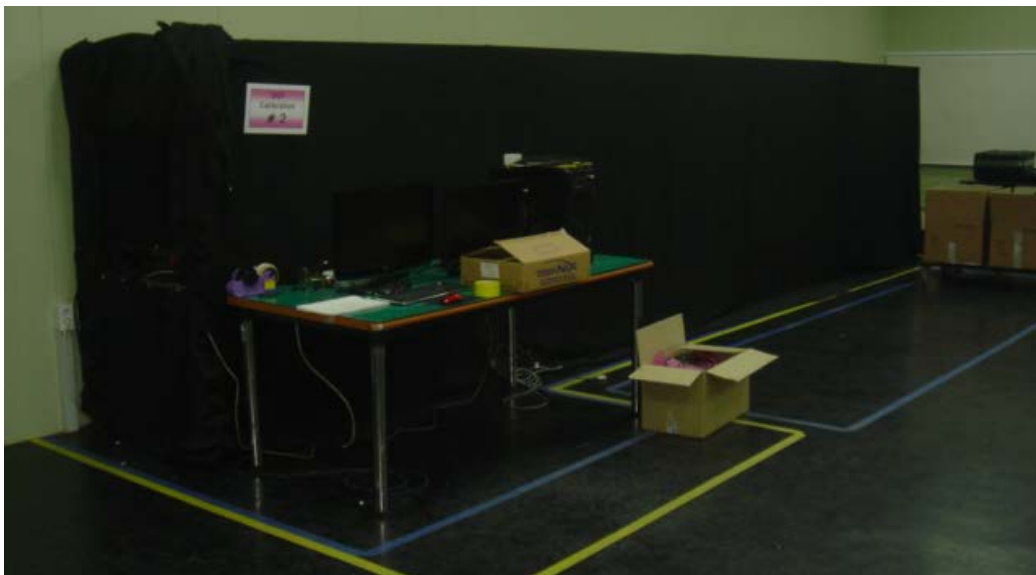
(2) Preparations for calibration devices

1) Prepare 4*8=32 or 5*10=50 rental cabinets of different batches to verify the calibration result. Dot pitch of cabinets and the size of cabinets must be the same.
2) In order to verify the calibration result, cabinets should had better to be of different batches and have differences in brightness and Chroma. However, the

scan method must be the same, otherwise we cannot use the same sender.

3) Sender and receiver should be of the same manufacturer.
4) Use receivers of the same type. The Linsn 801D receiver must have been upgraded so as to store calibration data, or use receiver of later than 802 version.
5) A laptop computer:
    i.   Operating system of later than win7 version;
    ii. Three USB interfaces.
6) CS200 chromometer, which is used to verify the calibration result.
7) Lighten the whole screen, set refresh rate to avoid flickering and be the best observation state of human eyes.
8) In the brightest state, display movable dot picture of horizontal and vertical intervals for 2 hours so as to ensure there's no LED that is blind or on all the time.
9) Remove the calibration data and watch differences in brightness, Chroma and uniformity of cabinets in red, green, blue and white.

(3) Calibration for a large number of cabinets

1) Cabinets with no chink
Photograph the first cabinet

Connect the cabinet to the computer running ColorSpaceServer, open ColorSpaceServer; Set up sender or video processor so that the screen corresponds with the controlling computer point by point; open ColorSpace on the Client computer. Create a new project, don't check Chink after correct, check Scan code; Control—Network—Connect; Control camera—Connect; Control camera—Find view, adjust the position of the tripod, the three knobs and the zoom ring; Control camera—delete region, set up delete regions to eliminate interferences; input an appropriate number in Control—Interval—Step; Adjust the focus ring, Capture—LED pixel number bigger than 45; regulate filter and aperture of the camera, Control—Display color—Value, Max of Chroma information histogram of green between 50000 and 55000; check location results respectively for red, green and blue, enter the biggest LED pixel number; check Capture—Box index—Number, enter Scan code, don't check Chink—Generate template or Chink—Fix; after the temperature of CCD arrive at which we select at the beginning, check Auto run, click on Main—Generate task and pay attention to location results; Save—simulation—Simulation and see the result of calibration.

Photograph the second cabinet

After the replacement of the cabinet, we still use the project before. Control—Network—Connect; Control camera—Connect; enter Scan code, don't check Capture—Background; after the temperature of CCD arrive at which we select at the beginning, click on Main—Generate task and pay attention to location results; Save—simulation—Simulation and see the result of calibration.

Photograph the following cabinets

After the replacement of the cabinet, we still use the project before. Control—Network—Connect; Control camera—Connect; enter Scan code, don't check

Capture—Degrade—Generate template, Degrade—Fix, Correct or Save; after the temperature of CCD arrive at which we select at the beginning, click on Main—Generate task and pay attention to location results.

Enter Line File Number (a divisor of total number of cabinets) in Main—Operate—Merge, and this number is number of cabinets in one row. Click on Group merge, select all fit files in led—1 file folder, click on Open. A table would be created in View display area and a <merge files succeed.> prompt box would be popped, click on OK. Pictures merged are saved in led—1—merge file folder. Right click on one picture merged and select Open group.

Fix degrade

Click on Capture—Degrade—Setting, enter x-Cabinet Number and y-Cabinet Number and select Smooth in Template Type. When photographing different cabinets, the camera don't move; aperture, zoom ring and focus ring of the camera are in the same position; different cabinets have the same resolution and are in the same position, check Average Template. If different cabinets have the same brightness before calibration, check Same Luminance.

Attention: Set Interval—Step the same with that when we photographed cabinets.

Click on Generate template, click on Fix.

Select a proper number in Correct—Sigma, click on Calc target, click on Correct.

Generate calibration data file

Operations in this step are the same with those in Iteration procedure of software 15. Main—Save—file correct—Format, Generate.

2) Cabinets with chinks

Photograph the first cabinet

Connect the cabinet to the computer running ColorSpaceServer, open ColorSpaceServer; Set up sender or video processor so that the screen corresponds with the controlling computer point by point; open ColorSpace on the Client computer. Create a new project, check Chink after correct and Scan code; Control—Network—Connect; Control camera—Connect; Control camera—Find view, adjust the position of the tripod, the three knobs and the zoom ring; Control camera—delete region, set up delete regions to eliminate interferences; input an appropriate number in Control—Interval—Step; Adjust the focus ring, Capture—LED pixel number bigger than 45; regulate filter and aperture of the camera, Control—Display color—Value, Max of Chroma information histogram of green between 50000 and 55000; check location results respectively for red, green and blue, enter the biggest LED pixel number; check Capture—Box index—Number, enter Scan code; click on Capture—Degrade—Setting, select All 1 in Template Type; after the temperature of CCD arrive at which we select at the beginning, check Auto run, click on Main—Generate task and pay attention to location results; Save—simulation—Simulation and see the result of calibration.

Photograph the second cabinet

After the replacement of the cabinet, we still use the project before. Control—Network—Connect; Control camera—Connect; enter Scan code, don't check Capture—Background; after the temperature of CCD arrive at which we select at the beginning, click on Main—Generate task and pay attention to location results; Save—simulation—Simulation and see the result of calibration.
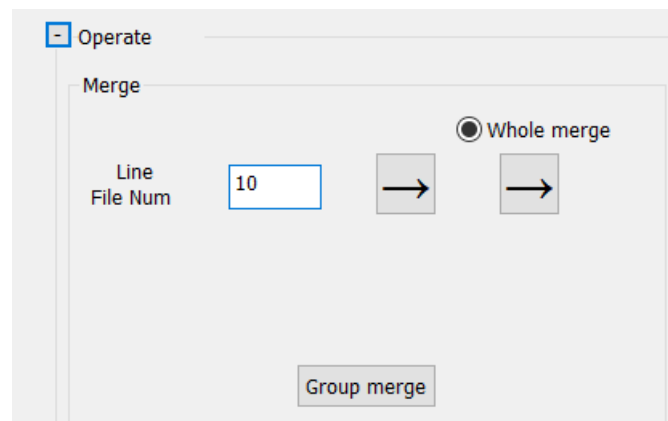
Photograph the following cabinets

After the replacement of the cabinet, we still use the project before. Control—Network—Connect; Control camera—Connect; enter Scan code, don't check Correct or Save; after the temperature of CCD arrive at which we select at the beginning, click on Main—Generate task and pay attention to location results.
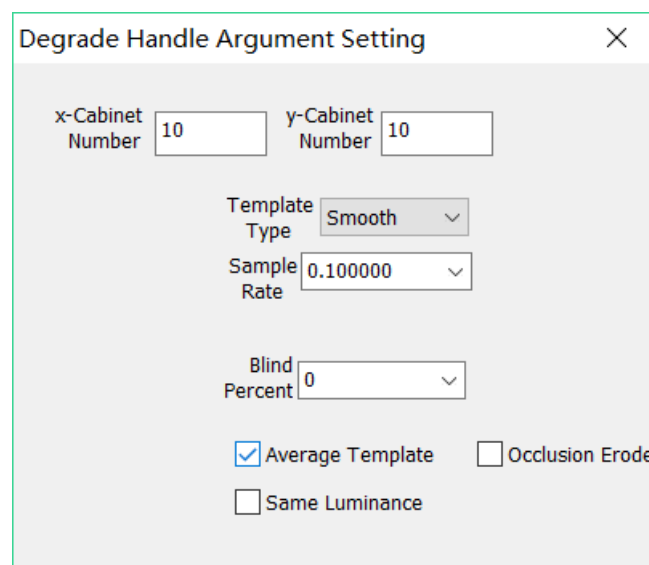
Merge

Enter Line File Number (a divisor of total number of cabinets) in Main—Operate—Merge, and this number is number of cabinets in one row. Click on Group merge, select all fit files in chink file folder, click on Open. A table would be created in View display area and a <merge files succeed.> prompt box would be popped, click on OK. Pictures merged are saved in chink—merge file folder. Right click on one picture merged and select Open group.

Fix degrade

Click on Capture—Degrade—Setting, enter x-Cabinet Number and y-Cabinet Number and select Smooth in Template Type. When photographing different cabinets, the camera don't move; aperture, zoom ring and focus ring of the camera are in the same position; different cabinets have the same resolution and are in the same position, check Average Template. If different cabinets have the same brightness before calibration, check Same Luminance.
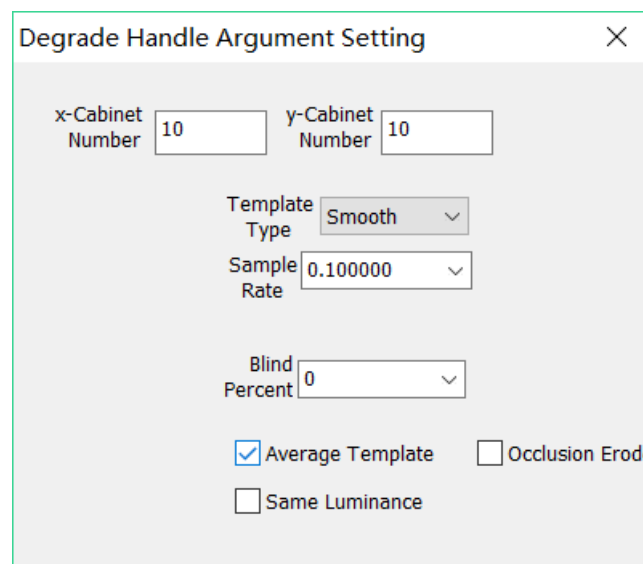
Attention: Set Interval—Step the same with that when we photographed cabinets.

Click on Generate template, click on Fix.

Correct

Select a proper number in Correct—Sigma, click on Calc target, click on Correct.

Generate calibration data file

Operations in this step are the same with those in 操作 procedure of software 15. Main—Save—file correct—Format, Generate.

3) Calibration for a great number of cabinets

If there are hundreds of cabinets or more to be calibrated, we could have the best calibration by following operations.

At first, we photograph 50 or 100 cabinets, merge fit files of these cabinets and fix degrade of fit files merged, which is the same with operations in previous section. We

will use degrade template and target data generated from these cabinets as those of following cabinets.

Correct

Select a proper number in Correct—Sigma, click on Calc target, click on Correct—Save, enter 168 in Operate password windows, a <save succeed.> prompt box would be popped, click on OK, check Correct—Load, click on Correct—Correct way—correct.

Generate calibration data file

Operations in this step are the same with those in Iteration procedure of software 15. Main—Save—file correct—Format, Generate.

Calibrate the following cabinets

After the replacement of the cabinet, we still use the project before. Control—Network—Connect; Control camera—Connect; enter Scan code; don't check Capture—Degrade—Generate template, check Degrade—Fix, Correct and Save; after the temperature of CCD arrive at which we select at the beginning, click on Main—Generate task and pay attention to location results. Finally, generate calibration data file.

2. Calibration at the scene

(1) Attentions and solutions for common problems

1） Screen corresponds with computer point by point

The principle of point by point calibration is that the screen corresponds the controlling computer point by point, control software must be set to 100% display proportions and device observes brightness and Chroma in this condition.

2） Processing method of borders

Some screens need to wrap around the edges for decorative reasons and there are two types of borders, regular borders (a whole row or column LED are covered) and irregular borders (a row or column LED are covered partly).

When we create a new project, area without borders on the screen is Display area. For example, resolution of the screen is 64*48, width of borders are 4 or the biggest width of borders is 4, Display area—StartX/StartY is 4, Display area—Width/Height is 56*40. When we accomplish photographing the screen, use AddDelete function to add data of borders. Enter 0 in the first AddDelete—Row/Col, enter 4 in the second AddDelete—Row/Col, click on Modify file, select all fit files in led—1file folder. Enter 44 in the first AddDelete—Row, 60 in the first AddDelete—Col, 4 in the second AddDelete—Row/Col, click on Modify file, select all fit files in led—1—add_del file folder. Then we get pictures whose resolution is the same with the screen in led—1—add_del—add_del file folder. We could open these pictures to see whether operations are correct. We use average value of pictures photographed to replace data of borders, so it's easy to find the area whose data are added.

(2) Fix chinks of same interval deviation

If chinks between cabinets or modules are due to technical reasons, as a result,

there're the same interval deviations between cabinets or modules, we could fix chink by following operations.

Notes: If interval deviations are different, we must photograph the whole screen so as to fix chinks.

1) Merge fit files of these cabinets and fix degrade of fit files merged, which is the same with operations in 1.Calibration in the factory1.3 Calibration for a large number of cabinets.

2) Click on Setting—Project attribute, set Screen—Width/Height, Module—width/Height the same with width/height of pictures merged, width/height of module respectively.

3) Right click on a fit file in degrade file folder, select Open group. Click on Capture—Chink—Setting, select User Define in Fix Way, Auto Calc Dynamic checked or not doesn't matter. If there're chinks between modules, enter proper numbers in Module—Up/Down/Left/Right; if there're chinks between cabinets, set Box—W/H the same with width/height of the cabinet, enter proper numbers in Box—Up/Down/Left/Right. Click on Chink—Generate template, click on Chink—Fix.

Notes: It's not certain that numbers in Box—Up/Down/Left/Right are proper. See pictures after fixing chink, if brightness or darkness of chinks in pictures is similar to that on the screen, these numbers are appropriate.

4) Click on Correct—Calc target. After generating target data, click on Correct—Correct way—correct.

5) If resolution of screen is smaller than output resolution of controlling computer, we could see the result of calibration, couldn't if not. Click on Save—simulation—Send, select r, g, b and w in Control—Display color to see the result of calibration. If we're satisfied, continue following operations; if not, amend operations based on problems, for example, fixing degrade, fixing chink, target data for correction, Sigma etc.

6) Generate calibration data file. Operations in this step are the same with those in Ⅱ. Operation procedure of software 15. Main—Save—file correct—Format, Generate.

Appendix I. Parameters of Photometer

Version	Resolution of CCD	Resolution of the screen photographable
PM-30	4250*2836	512*320
PM-25	3388*2712	420*320
PM-20	3326*2504	420*300