Mosaics with CCD Stack

Since I plan to do mosaics, and with help from Stan Moore who developed the software, I came up with a way of doing Tri-Color Mosaics and to get perfect registration using CCD Stack (http://www.ccdware.com). The hard part with color mosaics is not creating a single red, green, or blue image from the mosaic frames, but getting all the colors registered during the assembling of the mosaic. Black and White mosaics alone take time to assemble, but color is much more difficult. This is something I was not able to do in Photoshop CS because it requires manual rotation which can cause misalignment with each color. By using CCD Stack, I was able to position and rotate as needed to create four (4) registered images per channel that now could be taken into Photoshop without any additional rotation or movement. This was the key to registering the color channels perfectly. Using a simple procedure in Photoshop, the lines and any duplicate or distorted stars were easily removed, not altered or fixed. By removing parts of the layer that created these effects, I was able to restore the true stars that are in the image. This is not a hard procedure to do and is done faster than you would expect depending on the number of frames that make up the mosaic. There is no limit to the size a mosaic, but there may be a limit to computer memory.

Before you start, you need to do the normal process for each frame in the mosaic and for each color. This includes calibration, registration, data reject, and combine. Since this will go to Photoshop, I would suggest Mean combine which has the same S/N as the sum combine but is saved as 16 bit. Once this is done you are ready to start. I would suggest naming the files in the order of making the mosaic. This is mainly to help avoid confusion, and it's easy to get confused. So for this example, I used the following names:

- Red Image A – upper right
- Red Image B – lower right
- Red Image C – lower left
- Red Image D – upper left

This article outlines how to use CCD Stack to create mosaics that are register with each of the sub frames. It also covers how to take these images into Photoshop CS 2 and blend the mosaic into one large image without doing a lot of additional work.

PART A: Building the model

We need to build a model to register the other two colors. So let's start with red and get those images in position. Once this is done, getting the green and blue images registered for the mosaic is very simple.

Step 1

- Open CCD Stack and the 4 images to make up the red image of the mosaic.
- Now it is time to expand the canvas. Under the Edit menu, choose *Expand Canvas*. **Do not just double the width and height**; CCD Stack will think the images are binned and resize them. These images are 1530x1020 pixels, so I will use 3100x2100 as the new size. When you apply the size change, all the images will look smaller and be in the center.

Step 2:

- Using *Image Manager*, select the image just above Red Image A. If this image is on top, then pick the bottom image
- Choose the *Register* menu and click the *Manual* tab. For Strength, use *Coarse*. Move the image with the mouse to the upper right area; this should be red image A. You will see the area above and to the right go out of view. This is normal. The main idea here is to position the image in the upper right corner of the canvas.
- After you have moved it into position, click the *Apply* tab and *Use Nearest Neighbor*. Click the button "Apply to This", and then close the register dialog. This puts Red Image A in the correct location for the mosaic. http://www.galaxies.com/images/step2.jpg

Step 3:

- Since we have 4 images, and to avoid confusion, we need to be sure that red Image A is the reference image for the registration, and the one we want to move is Red Image B. So bring up Image manager and change *Include* to *N* for Red Image C and D so that they are not included.
- Now you can select the Red Image A in *Image Manager* to make it the reference image and click on the register menu. Now move the image, which should be Image B, down to the lower right part of the canvas and get it as close as possible to Red Image A so that the same stars in both images can be registered.
- Use the *Star Snap* tab, and select 2 or 3 stars that are in both images and use "Snap This" to lock it into position. You must use stars in both images for this to work.
- Now click the *Apply* tab and use *"Bicubic-B Spline"*, click the "Apply To This" button. This will place Image B in the lower left corner in the right position. http://www.galaxies.com/images/step3.jpg

Step 4

- Now we need to repeat Step 3 for Red Image C and D.
- For Red Image C, be sure that Red Image B and C are the only included files in Image Manager. Use Red Image B as the reference, then move and position Red Image C the same way you did in step 3.
- For Red Image D, be sure Red Image C and D are the only included files, and use C as the reference. When you blink the images, you should have your images in the correct position. http://www.galaxies.com/images/step4.gif

Step 5

- Now that the 4 images have been registered and put into the correct position, you should save the FITS Files now using Save All.
- If you want to see the mosaic image now in CCD Stack, use the combine menu. However, this will also show the lines and possible duplicate or distorted stars. The duplicate stars are caused by rotation in the sky, since the sky is not really flat. When we get to Photoshop CS 2, you will see how easy it is to fix the lines and duplicate/distorted stars.
- Note that with additional work in CCD Stack, it is possible fix some of these issues such as the lines and contrast from one image to another. You can use the blink to jump from one image to another and use Adjust Display as needed.

PART 2 – The other colors

Step 1

- We are now ready to register the other colors.
- Close all the images and open the saved Red Image A with the expanded canvas. You should see this image at the upper right corner.
- Next open the Green and Blue Image of the same area of Red Image A
- Make sure Red Image A is the reference image.
- Now move the first image (green or blue) close to Red Image A so that you can register the stars in both. Do not register it yet.
- Next use Image Manager to select the image that you did not move and move that close to Red Image A
- Once that image is moved, use Image Manager to make Red Image A the reference.
- Now that the images are moved, you can register the red, green, and blue images as you would normally do in CCD Stack.
- Save all the FITS images

Step 2

- Repeat Step 1 with the other 3 frames to complete the task.

Step 3

- You are now ready to save the images as Scaled 16 bit TIFF file for Photoshop. Close all opened images. Then open all the images for all the colors. Use the Save All and choose Scaled 16 bit tiff files. You are done with CCD Stack for now.

PART 3 – Putting it all together

Using PhotoShop CS 2 will make the task of removing contrast lines, duplicate and distorted stars, and adjusting contrast a little easier. However, it is possible to solve all of these issues in CCD Stack in the event you do not have Photoshop CS 2; however, I am assuming you have this software. Photoshop CS or higher supports 16 bit layers, so you really need this, although earlier versions will allow you to do the same thing, but only with 8 bit files. You need to be familiar with the layers pallet and creating and using a layer mask. However, I will tell you briefly how to create and use a layer mask since it is important.

Step 1

- Open the four Red Images to make up the mosaic.
- If you do not see the Layers Pallet, make it visible (Window/Layer menu).
- Select Red Image A and right click on the image in the Layer Pallet and choose *Layer From Background.* This makes the background image a layer.
- Select and copy Red Image B, and paste it on top of Red Image A.
- Select and copy Red Image C, and paste it on top of Red Image A.
- Select and copy Red Image D, and paste it on top of Red Image A.
- When you are done, Red Image A should be a bottom layer, B is on top of A, C is on top of B, and D is on top of C. http://www.galaxies.com/images/step31.jpg

Step 2

- The layer mode is set for *Normal* on each of the layers. This will need to be changed to lighten mode on each layer, and this reveals the mosaic.
- Here you can use *Curves* or *Levels* to adjust each layer to get them as close as possible thus removing the lines. What you can't fix can be done with a layer mask.
- The next step is to create a layer mask for each layer. The way to do this is select the layer in the layer pallet and select *Reveal All*. This puts a small box to the right of each layer.
- Set the foreground color to black and the background to white
- To see what the layer mask can do for you, select the brush tool, and set the size of the brush to a good size. Set the Opacity to 50%. Click inside the box on the top layer. Now move the brush over the image. It should be erasing the top image and showing the image under it. If you switch the colors so that white is the foreground color, you undo what you erase. (Look in the Photoshop help for more on Layer Mask.)
- By using the layer mask, you can remove the lines, duplicate stars, and distorted stars. The trick is learning how to use the Layer Mask to do the work for you.

Step 3

- Once you have a good clean image, you can flatten the layers under the *Layer* menu. Do steps 1 and 2 again for each color. At this point you have 3 TIFF files for the RGB image and can use whatever method you use to make the color image.

I have written this document for those who want to use CCD Stack to create mosaics. What is unique about CCD Stack is that it can create sub frames that make up a mosaic that you can take directly to Photoshop. In this software you can work with each frame on its own by using layers. I have uploaded the 4 combined images so that you can practice assembling the mosaic. Since it is very easy to do green and blue once red is done, I uploaded only the red images. Feel free to contact me via my web site at www.galaxies.com

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