Leica Geosystems HDS

Cyclone External Camera Workflow-Nodal Ninja bracket

High-Definition Surveying

Version 1

Cyclone External Camera Workflow-Nodal Ninja Bracket

High-Definition Surveying

Objective:

Creation of high quality images (cube maps) that can easily be textured mapped into a point cloud in Cyclone

Concept:

After scanning, a camera, fitted to a special bracket, replaces the scanner. The bracket is placed on the same tribrach the scanner used.

A fish eye lens mounted on the camera is positioned on the bracket so that the focal center of the lens matches the optical center of the scanner (this is important for accurate image-to-point cloud texture mapping). The captured images are joined using special third party software to form cube map images (required by Cyclone). Then, in only a few minutes, images can be easily imported to Cyclone, and with only three matching picks, fully texturize a full dome scan. The same full dome texturing of a point cloud using the usual workflow would take several images and 50-70 matching picks.

Required Software:

Cyclone Model , Scan or Survey

The following software is provided in this workflow:

PTgui-for stitching the camera images into spherical or equirectangluar image

Panotools-a necessary plug-in for PTgui

Pano2QTVR Gui-for conversion of the equirectangluar image into Cube Maps

Procedure

There are four stages to the workflow:

- Camera setup and image capture
- Installing the stitching and Cube Map creation software
- Stitching of the images and creation of a Cube Map
- Importing of the Cube Map into Cyclone and texturing the point cloud

Contents

Setting up a new Nodal Ninja Camera bracket

If you have just purchased a Nodal Ninja bracket, please follow these setup instructions before proceeding to the next section.

1. **Open case from Nodal Ninja and inspect contents:**

Exploded view

Cyclone External Camera Workflow-Nodal Ninja Bracket

High-Definition Surveying

Insert 60 degree Brass Detent plate:

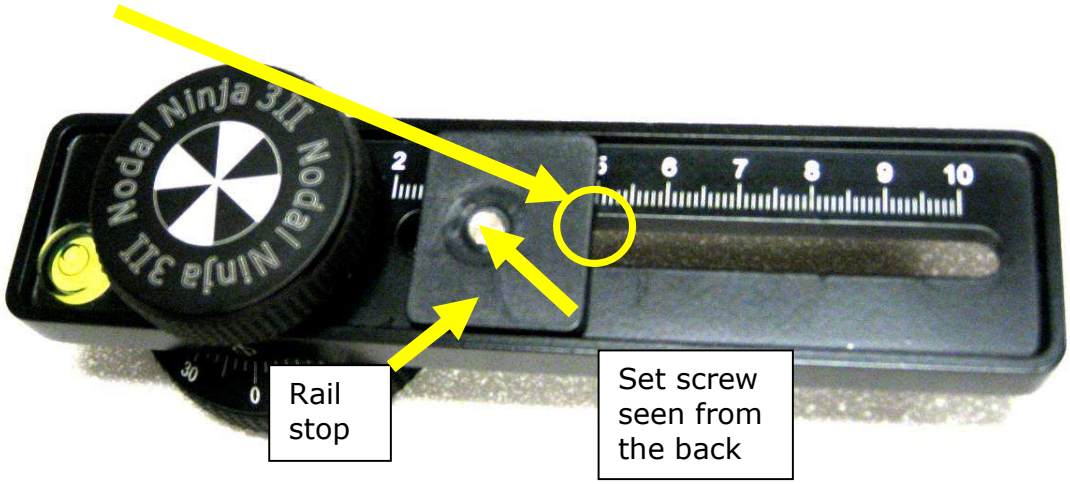
a. Remove the bottom bracket from packaging and unscrew the top fitting as shown in image.
b. Remove the current detent plate by prying it loose with a coin, find the 60-degree detent plate in packaging and place in bracket and reassemble.
c. The bottom bracket should look like the image in step 3 after you are done.

60 Degree Detent plate

Top fitting

2. Set Stop bracket on bottom bracket:

a. Take out the bottom bracket and loosen set screw and set the bottom bracket stop to 50mm (rotate the stop bracket as shown) and tighten screw:

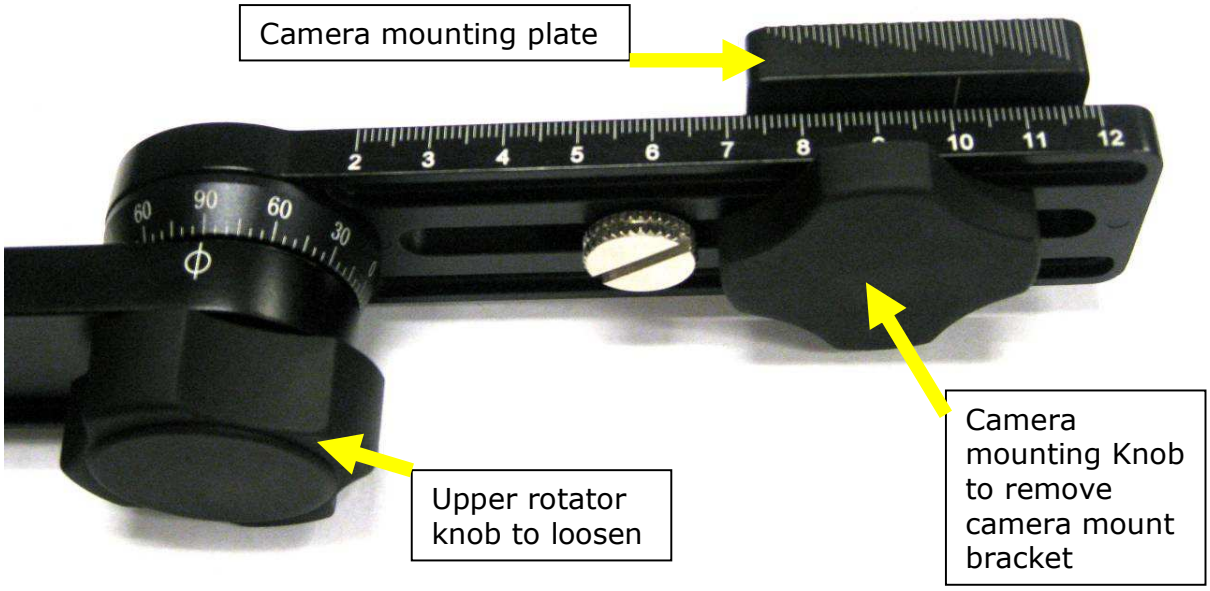


Rail stop

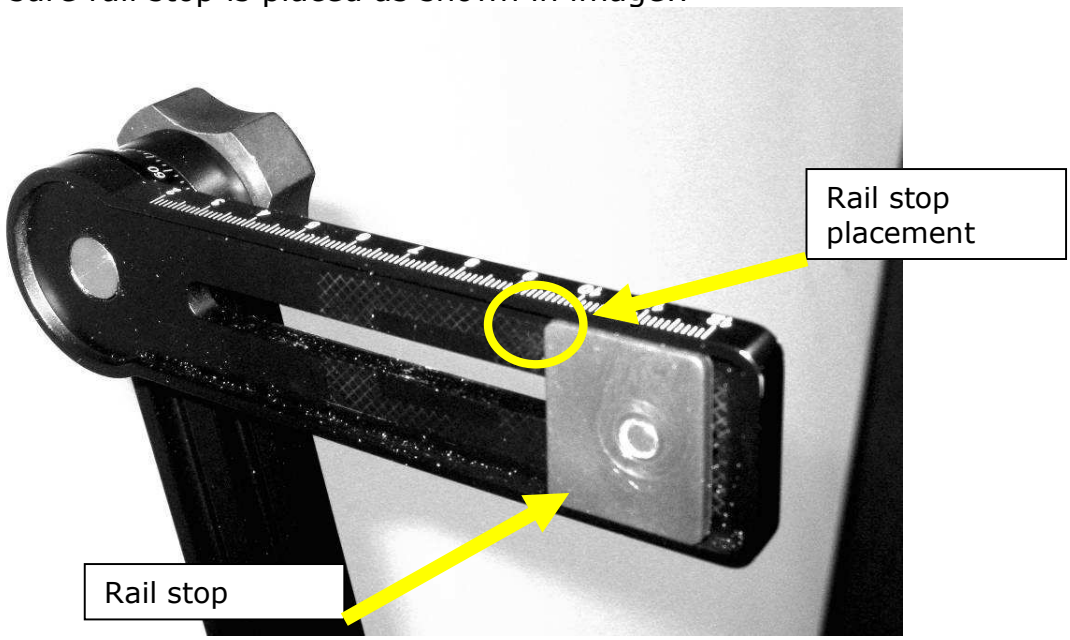
Set screw seen from the back

3. Set Stop bracket for Top bracket:

a. Take out the Top bracket loosen Camera mounting Knob and swing open.
b. Remove the Camera mounting plate by unscrewing the Camera mounting Knob:

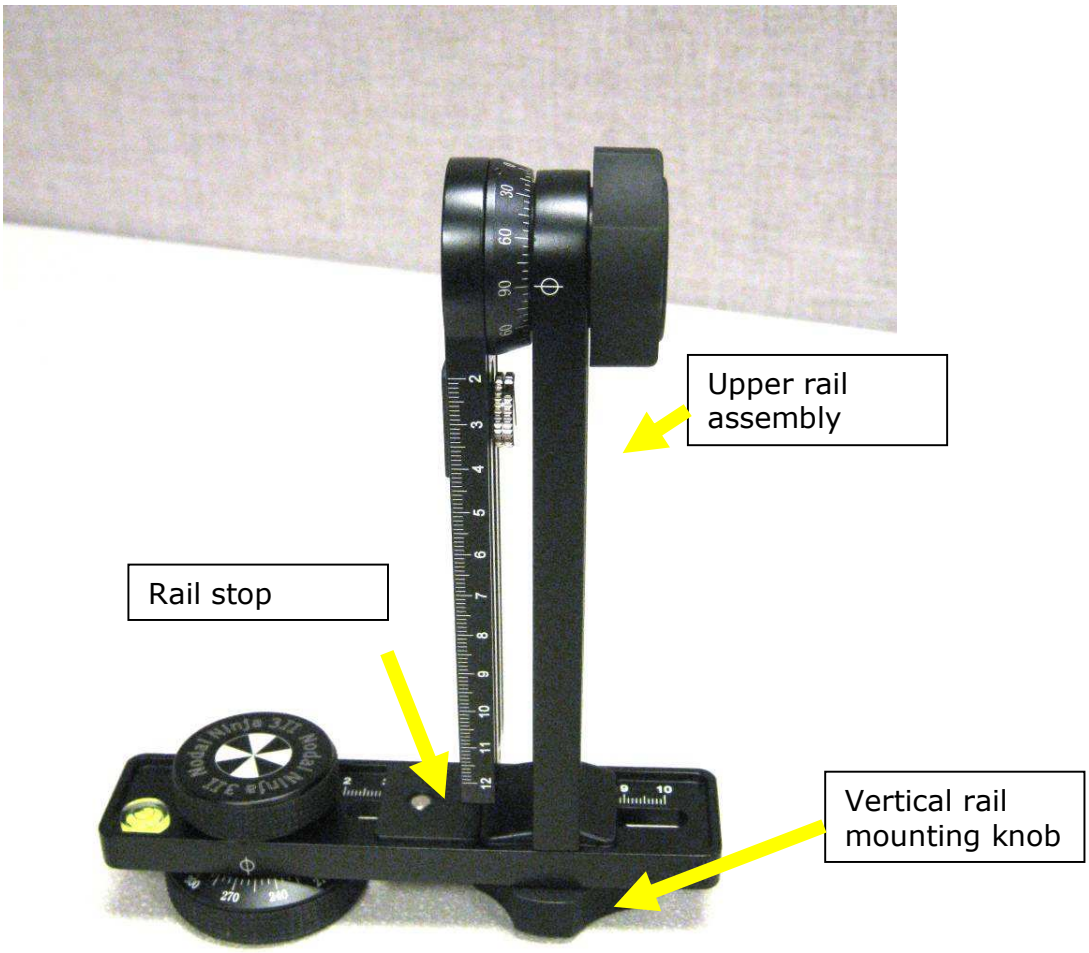


c. Set the Stop bracket edge to **100mm** on top bracket scale as shown and tighten screw:
d. Make sure rail stop is placed as shown in image!!

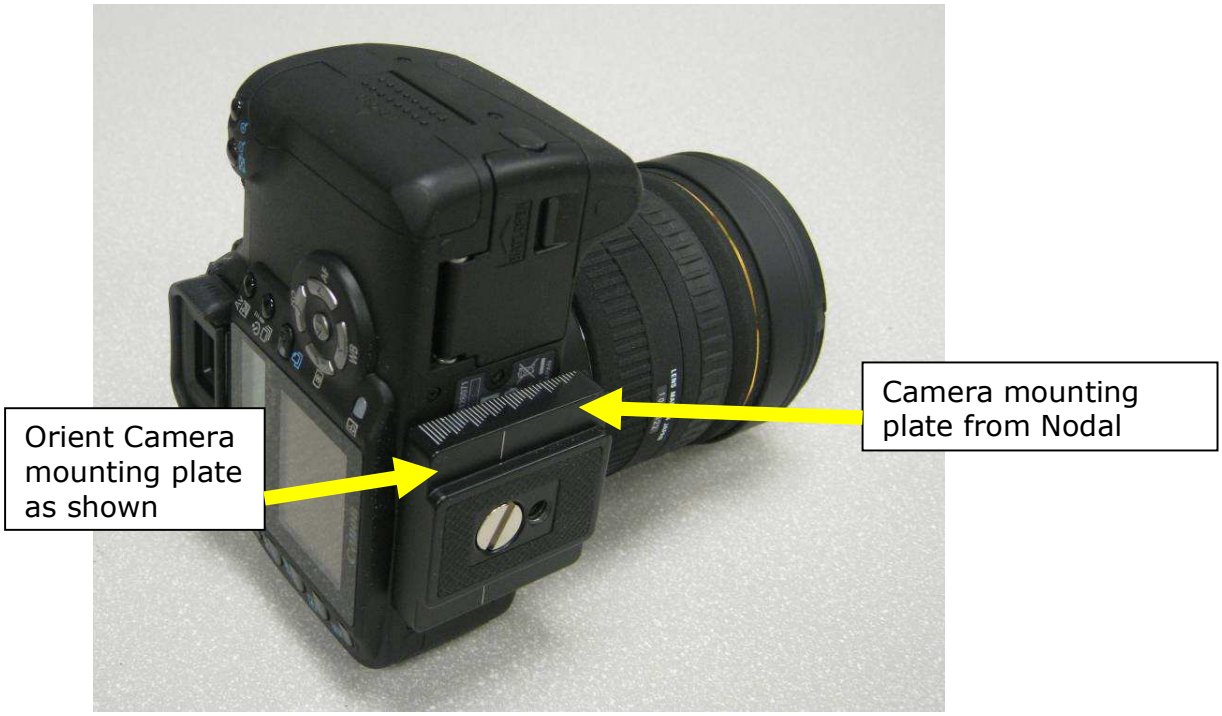


4. Place Top bracket up against the bottom bracket stop as shown and use the provided Camera mounting Knob to attach:

Note: There are two thumbscrews and they are both are different. Make sure you use the correct one. The thumbscrew with the inset is the one used to mount the camera. The other should be used in this step.



5. Attach adaptor plate to Camera:
    a. Remove camera from box and locate screw hole on the bottom
    b. Locate Camera mount plate, removed from the Top bracket in step 4.
    c. Attach Camera mount plate to camera as shown and tighten screw snuggly (notice the orientation of plate):
    d. Camera will be mounted to the bracket in the next section.



Completed assembly:

6. Continue with the next section when finished

Camera setup and image capture

For the initial setup, please follow the procedures listed below by setting up the camera mount, one piece at a time, on the tripod. For subsequent setups, the entire mount should be assembled before hand and then installed on tripod. This helps minimize movement of the tripod while switching out the scanner for the camera mount.

The instruction below explains how to setup the camera properly so that the center or Nodal point of the lens is in the exact focal center of the bracket. This is necessary for the panorama to have as little parallax (lens and image distortion) as possible. Every camera and lens combination has a different Nodal point. Please do not adjust any screw unless you are instructed to do so. **This workflow manual is designed to work with the case of pre-assembled parts as shown below. If you are working with a newly purchased Nodal Ninja Bracket please use go to Setting up a new Nodal Ninja Camera bracket section on page 3.**

1. Carefully remove scanner off tripod if using while scanning.
2. Remove the Top and Bottom bracket from case. Set the Top bracket in place in the Bottom bracket up against the Stop bracket. (Screw Top Bracket to Bottom bracket using thumbscrew.

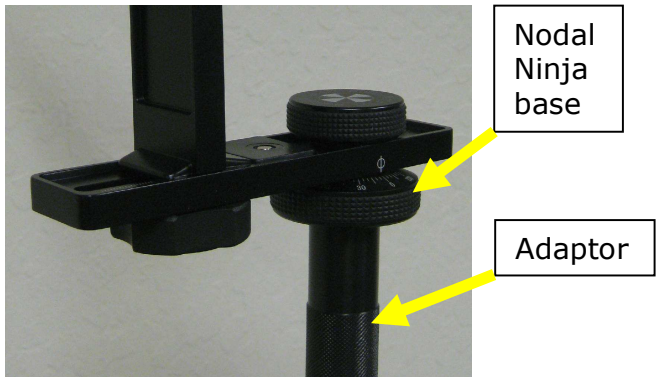
Note: There are two Mounting Knobs and they are both are different. Make sure you use the correct one. The thumbscrew with the inset is the one used to mount the camera. The other should be used in this step.

3. Attach Adaptor to tribrach adator and lock:
    a. There are two different size adaptors, the shorter one for the HDS6000 and the longer one for the ScanStation\HDS3000.
    b. Choose the appropriate adaptor and attach to the Tribrach adaptor:

Tribrach adaptor with HDS6000 Adaptor

4. Attaching the Nodal Ninja to adaptor

    a. Hold the Nodal Ninja by the base and rotate the adaptor until tight.

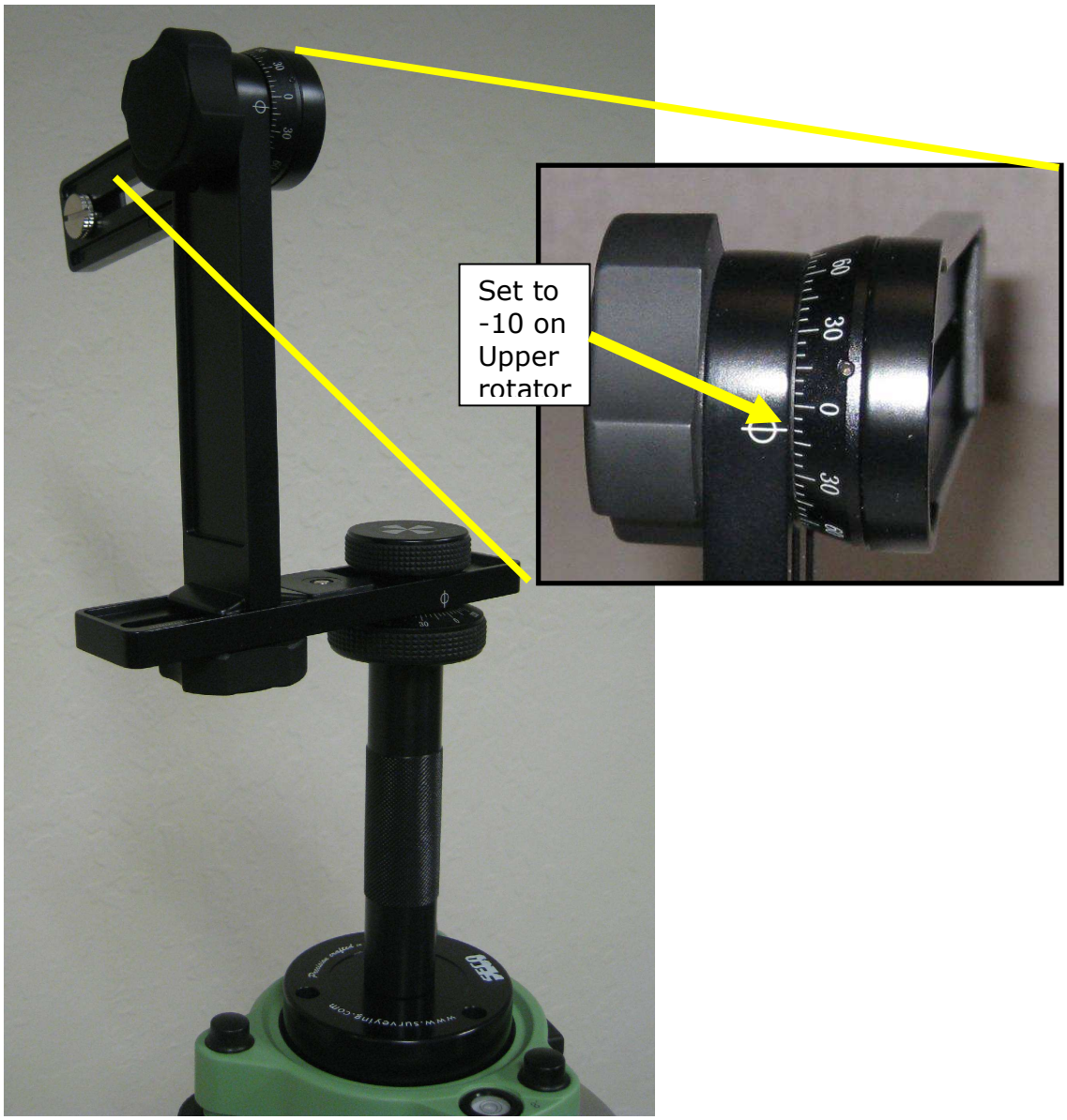


5. Rotate top bracket into position:

    a. Loosen the large black knob on the bracket's upper bracket

    b. Looking at dial, rotate the top bracket up into place until the dial is set to -10 degs.

    c. When properly set up the top bracket will be slightly tilted down on the side. This is normal and is needed to cover the whole field of view.



6. Attach camera to bracket:

   a. Remove camera from case. **DO NOT REMOVE OR ADJUST BRACKET ATTACHED TO CAMERA!!**

   b. Set camera into the Nodal Ninja's top bracket as shown and attach with screw provided:

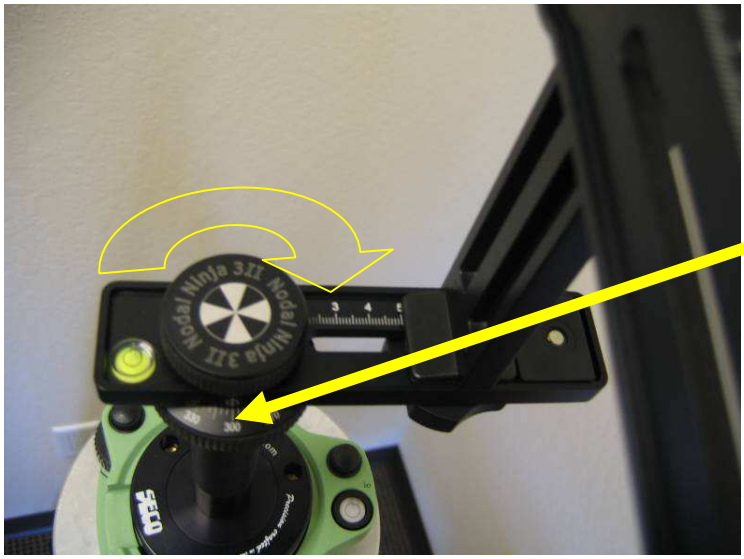
Seen from the back

5. If the camera battery is low, replace with the other battery provided and recharge the low battery with the battery charger located in case.
6. Remove lens cap **and** ring. **<u>Both the lens cap and the ring the lens cap sits in.</u>**

   Make sure your hands, other body parts and anything else in the way is moved before image capture. *The lens has a 175 degree field of view and you can easily get in the way.*

7. Rotate bracket to the first position:

   Rotate camera to the first stop at the 0 degree mark on indicator. You should feel it click lightly. The bracket rotates in 60 degree increments



Rotate bracket until you feel it "click in" then take first image.

8. Take the first image.
   a. Turn on camera. Switch is on the right top side of camera.
   b. Rotate to the next position and take the next image.
   c. You should take six images in the horizontal plane, one every 60 degs.

   If the camera will not take an image (the lens focuses, but no image is taken) then turn the automatic focus switch to manual. Switch is located in lens body.

9. This completes the image capture. No up or down image is needed.
10. Remove the camera card from the camera and use the provided USB camera card reader to load the images on to the laptop where you plan create the Cube Map images.

Question on Camera setup? Contact Guy Cutting 925-785-7753
guy.cutting@lgshds.com

Texture Mapping Point Clouds with Panoramic Images

After you take the panoramic images with the camera kit, and transfer the images from the camera to a computer, you need to convert them to a spherical (also known as equirectangluar) image in PTgui. You then convert that spherical image into Cube Maps that the Cyclone software will synchronize with in order to complete the workflow.

1. **Install PTgui**:
   - On the attached data disk, go to the **Camera Workflow data\Programs\PTgui** folder and run the **PTgui 6.0.3 Setup.exe**. Follow the instructions in the Setup process.

2. **Register PTgui software:**
   - This process is complete, the PTgui software should be open. **You will need to go to www.ptgui.com and acquire a license ($100)**. Click on **Help** on the Toolbar. Then click on **About** and at the bottom of the screen, click on "**Register** . . ."

3. **Install Pano tools plug-in:**
   - Go to the **Camera Workflow data\Programs\Pano tools** folder and run the setup.exe. At the prompt that asks if you want to install plug-ins for Photoshop 7.0, click "**No**".

4. **Apply setting file to PTgui:**
   - Open **PTgui** by clicking on the shortcut that you created in the installation process, and go to **File-Apply Template**. Browse to the directory **Camera Workflow data\Programs\PTgui** and load in the setting file **PTgui setting.pts.** This file sets all the necessary settings in **PTgui**.

5. **Load images into PTgui:**
   - On the first page of PTgui click on the **Load image…** button. Browse to the folder **Camera Workflow data\Sample Data\Images from Camera** or your own images and load all the images. This may take a few minutes. Click **ok** on the Camera\lens data dialog window that pops up.

6. **Viewing candidate image:**
   a. Click the **Align Images** button. Wait a few minutes for PTgui to align images.
   b. The Panorama Editor window comes up and you should see the images open randomly and then adjust to match each other in real time (see image below); if not restart PTgui.

c. If the images do not appear to align well, go to **Mode-Edit individual images** in the **Panorama Editor** window. You can now click on individual images and move them into place. The images provided in this example will align correctly. (See image below). Unless there are very few unique objects in the overlap areas of the images (think Cloud-to-Cloud reg), your images should align correctly without manual adjustment.

d. You can also run the optimizer to help align the images. Go to the **Optimizer tab** at the top of the screen and choose the **Panorama tools** option using the pull down in the lower left. Click the **Run Optimizer** button. Click OK to the dialog that comes up.

This is what the image should look like in step 6
If the image is upside down this is ok. You can rotate it after the spherical image finished

7. Create panorama:

a. Click the **Create Panorama** button on the **Project Assistant tab**. This will take you to the **Create Panorama Tab**. Click the Create Panorama button. You will be asked to save the image – give it a title of your choice and select a location for the file and **Save**.

8. Close PTgui when alignment (stitcher) finishes.

9. Viewing the completed spherical image:

a. Go to the location where you saved the file and open the image using the windows default viewer. It should look like the image below if the workflow was successful.

Spherical image created with PTgui

If the Spherical image is upside down, use any image editor (Window Image viewer will work) to rotate the image right side up **BEFORE** proceeding to the next step.

Install Pano2QTVRGui:

b. Go to the **Camera Workflow data\Programs\Pano** folder and open the **Pano2QTVRGui_Installer_v1_6_2.exe** to install the next set of software. This software converts the image shown above into a Cube Map. This software also creates a QuickTime movie of the panorama.

10. Open Pano2QTVRGui and make and save a project:

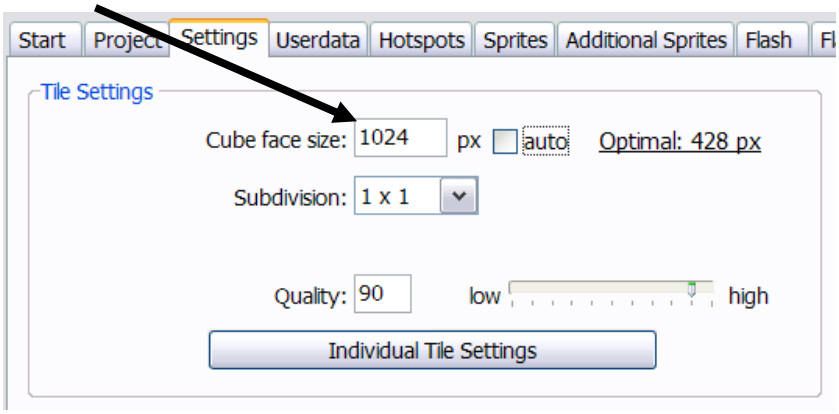
a. Open the program **Pano2QTVRGui** and click the **Create a New Project** button. Browse to the directory of the spherical image you created earlier in **PTgui** and name the project and click S**ave**.

11. Open Spherical image:

a. In the **Projects** tab under **Project type,** click the small button next to **Equirectangluar** and browse for the image you created earlier in **PTgui** and click **Open**.

12. Convert images to Cube Maps

a. Go to the settings tab. In the upper left box choose image size of either 1024 or 2048 (use 1024 if 2048 does not work in Cyclone and or TruView)

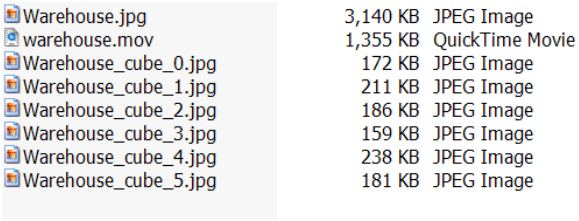


b. Click the project tab and click the **Convert to Cubic** button, choose jpeg in the pop up dialog, and click OK.

c. The cube images are in the same directory as the original spherical image.

13. Examine the Cube Map Directory:

a. Open the directory and look at the Cube Map images. The directory should look something close to the image below.



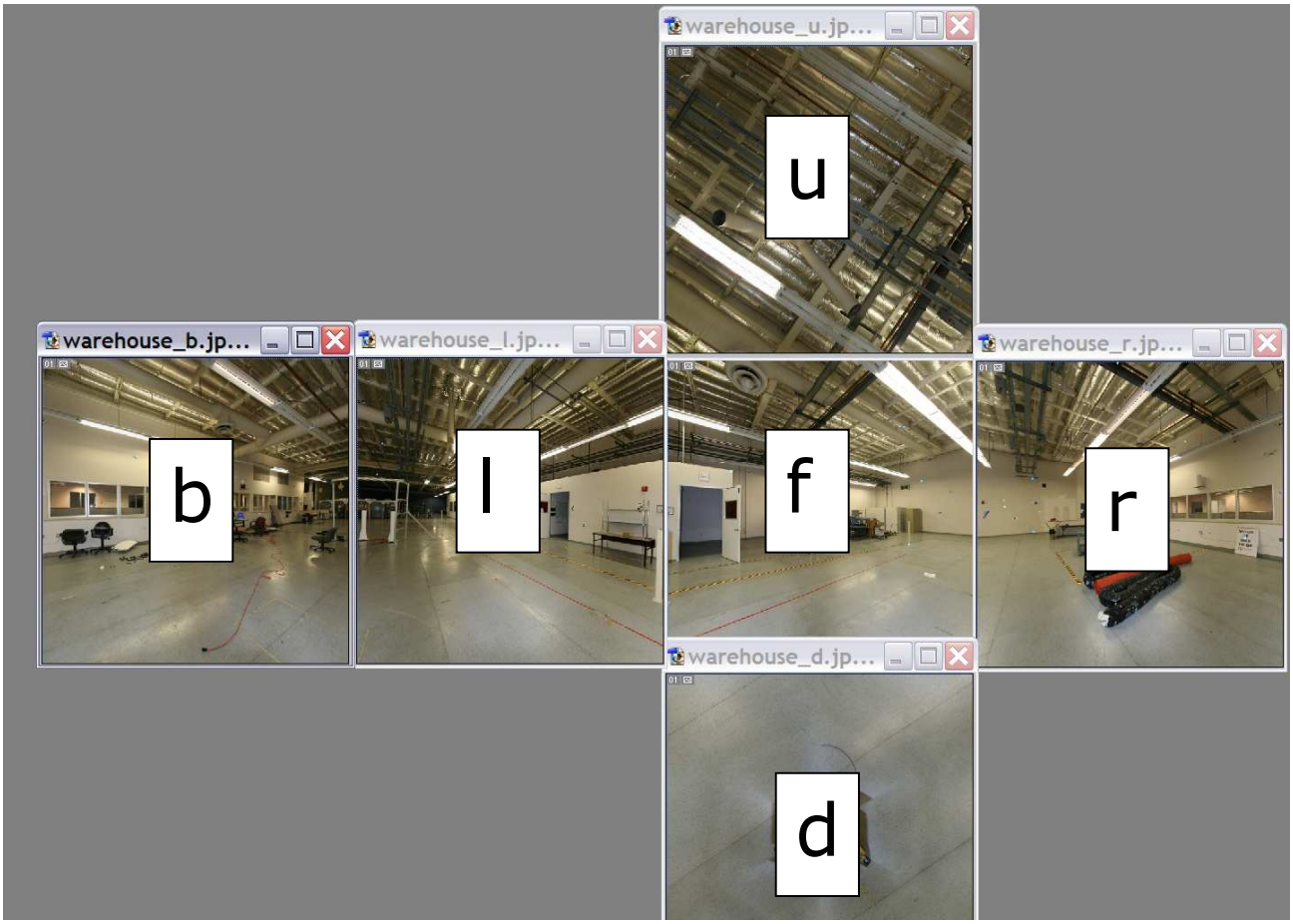
b. You can open the Warehouse.mov file and check out the movie.

14. Rename Cube Map files automatically using a batch process:

a. Copy the file **cube image renamer.bat** from the **Pano2QTVRGui** data directory and paste it into the folder where you have you cube images. Double click the **cube image renamer.bat** file. The cube images will be automatically renamed in the proper order. Please check below for how to check image naming.

******Important******

f=front u=up r=right l=left d=down b=back



15. **Cube map creation completed**

Import cube images into Cyclone

A complete end-to-end movie of the entire workflow is in the data directory under **Camera Workflow data\Process movie PTgui to Cyclone**

You can use the example IMP database in **Camera Workflow data\Sample Data\Cyclone Database\warehouse.imp.** This database matches the warehouse images in the PTgui section above.

1. **Importing images into Cyclone**:
    a. Open Cyclone and browse to the ScanWorld's image folder
    b. Right click on the image folder and choose import. Select all the cube images and click ok.

2. **Select cloud/clouds**:
    a. Open a ModelSpace containing the clouds you wish to texture map. Select the clouds and merge them, only if there is more than one point cloud you want to texture at once. Then go to **Create Object-Merge** to merge all clouds into one object.

3. **Add Cube Map images**:
    a. Go to **Edit Object-Appearance-Texture Map Browser.** Make sure to have the cloud selected. Click the  (add cube map images) button in the **Texture Map Browser.** Browse to the image folder in the **Select Project with Cube-Map Image** dialog and click OK.

4. **Adding constraints (matching picks):**
    a. You need at least 3 pairs of matching picks to compete the texture mapping
    b. Select the points that define a corner, edge or other well defined point.
    c. Select first pick in the image dialog (cube map)
        i. Click and hold down the left mouse in the dialog (notice the zoom to enable accurate picking)
        ii. When you release the mouse a pick will be left behind
    d. Next pick a matching pick in the point cloud window
    e. Click the  (add constraints) button in the Texture Editor dialog (the smaller one).
    f. Right click in the **Texture Editor (image) dialog** and select another image, either front, back, right, left, or up and pick another matching set and click the  in the **Texture Editor** window.

g. If the fit is bad go back and add more picks. You can add multiple picks to each cube. On scans of streets or roads with long distances, more and better picks are required.

h. Do this again in another view, either front, back, right, left, or up and click the button again.

i. You only need three matching picks

j. Click the button in the texture Editor Window (the small one) to compute the fit.

k. Click close to all dialogs.

5. Change Cloud to New Colors from Cube Map:

a. Select point cloud and go to **Edit Object-Appearance-Apply Color Map-Image Texture Map** to see the new colors from the Cube Map.

b. If you do not see the cube map colors go to **View\Global texture Map** and make sure it is checked

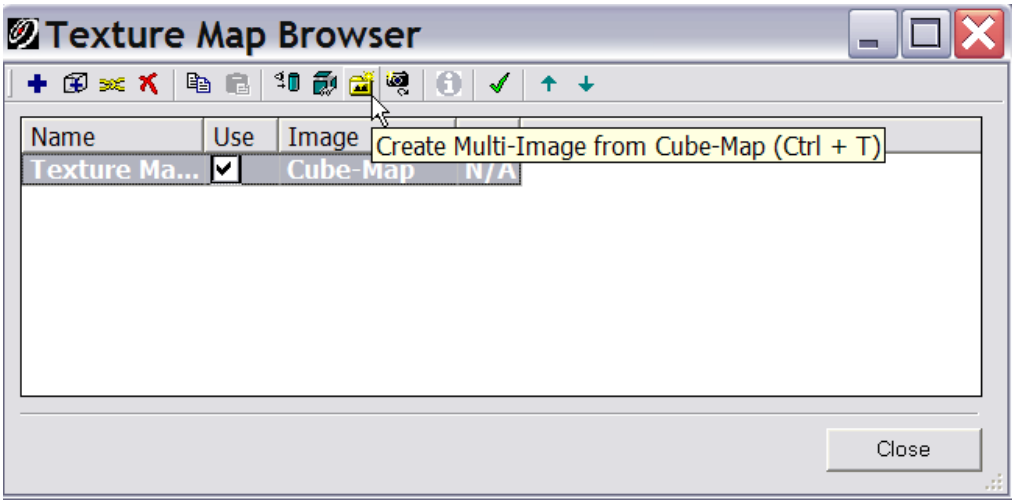
c. Check under **Edit Object-Appearance-Global Color Map** and make sure global color map is turned off

d. If the fit is not correct go back to the Texture Map Browser and double click on the image, this will open the contain dialog, and add and or delete picks to get a better fit.

6. Create Multi-image from Cube map(Available in Cyclone 5.8):

You can create a Multi-Image from the Texture Map Browser dialog. This enables the ability to create a TruView and have the new imagery available in the TruView.

a. Click the button in the Texture map Browser dialog (See image below). A Multi-Image will be created. You can view the new Multi-Image under the Scan folder of the ScanWorld in the Cyclone Navigator. If you get an error that means that, the cubes are not 1024x1024 or 2048x2048. Remake the cubes in Pano2QTVR.



7. **Create a TruView with the new Multi-Image:**
    a. You will need to "Burn" the colors to the point cloud to make the point cloud show the new colors in the TruView. This is because the only option beside intensity map is "colors from scanners" in the TruView publisher dialog. In step 6 above check the green check button in the Texture Map Browser to burn the colors to the point cloud and restart Cyclone
    b. The TruView Publisher will use the first Multi-Image in the Image folder. When you created the Multi-Image from cubes on step 6 above, Cyclone named the new Multi-Image- Multi-Image2. You need to cut and paste the original Multi-Image- Multi-Image1 and paste it into another folder (just create a new one).
    c. When you publish the TruView make sure you check the **Use Backround image** box in the Publisher dialog that comes up.

8. **Workflow finished**

Listing of necessary items for the Panoramic Application

CAMERA:

CANON DIGITAL EOS-350D OR XT COST~$500.00 US

BUYING A FULL FRAME CAMERA WILL GET YOU MORE FIELD OF VIEW THAN THE LOWER PRICE 350D USED FOR THIS DEMO. SEE IMAGES BELOW. COST OF FULL FRAME CAMERAS START AT $3000.00 US

Image A- Image from demo camera 350D

Image B Full Frame

NOTICE IN IMAGE "A" THE SIDES OF THE CIRCLE ARE SLICED OFF. THIS IS FROM THE CANYON 350D CAMERA USED ON THIS DEMO. THE FULL FIELD OF VIEW OF THE LENS WILL BE CAPTURED IF THE EXPOSER AREA IN THE CAMERA IS FULL FRAME (IMAGE B) BUT AS NOTED ABOVE, THESE UPPER LEVEL CAMERAS COST MUCH MORE. YOU DO NOT NEED THIS TYPE OF CAMERA UNLESS YOU REALLY NEED THE EXTRA RESOLUTION AND THE INCREAED FIELD OF VIEW TO ENABLE A FULL DOME PANORAMA WITH ONLY 5 IMAGES.

FISH EYE LENS: PURCHASED AT **WWW.AMAZON.COM**

Sigma: 8mm f/3.5 EX DG Circular Fisheye Lens for Canon SLR Cameras

COST~$700.00 US

ALL CAMERA MOUNT HARDWARE BESIDES CAMERA AND LENS:

GO TO

http://store.nodalninja.com/category_s/37.htm

TO ORDER THE PARTS:

N3II-PKG-HDS6000: COST $299.00
Exclusively for use with Leica HDS6000
Includes: Nodal Ninja 3 MKII Complete Package, 1ea. N3HDS6000 Camera Adapter, 1ea. 2010-00 Tribrach Adapter.

N3II-PKG-SCA: COST $299.00
Exclusively for use for use with Leica ScanStation
Includes: Nodal Ninja 3 MKII Complete Package, 1ea. N3SCA ScanStation Camera Adapter, 1ea. 2010-00 Tribrach Adapter.

DOWNLOAD TO MANUAL FOR NODAL NINJA BRACKET:

http://www.nodalninja.com/nn3_user_manual.pdf

PELICAN CASE #1400 COST~$69.00

CAMERA IMAGE TO SPHERICAL IMAGE SOFTWARE:

ALL OF THIS SOFTWARE IS AVAILABLE ON THE CAMERA SITE

PTGUI: COST $100.00
www.ptgui.com

FREE SOFTWARE:

PANO TOOLS

NECESSARY PLUG-IN FOR PTGUI:

FREE AND INCLUDED AT:

http://software.lgshds.com/public/camera/

PANO2QTVR

SPHERICAL IMAGE TO CUBE MAPS

FREE AND INCLUDED AT:

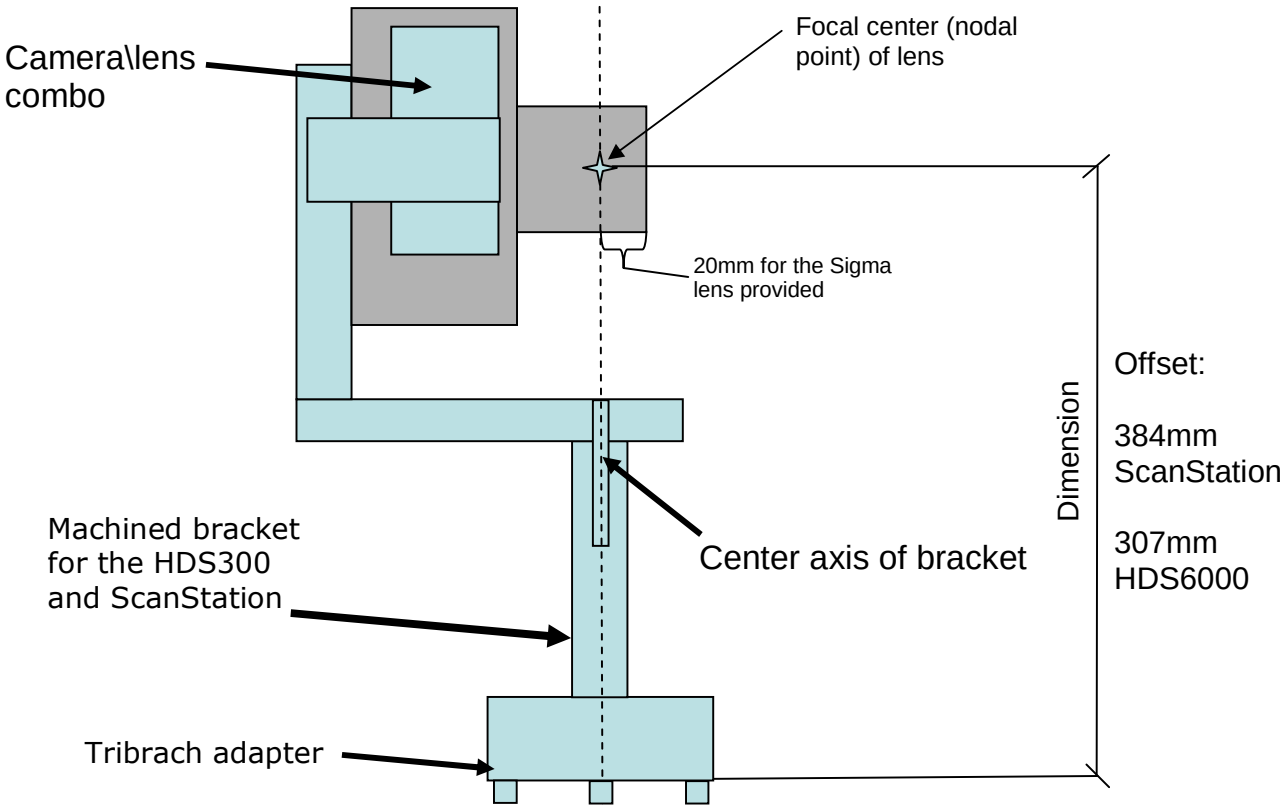
http://software.lgshds.com/public/camera/

Using your own camera and bracket for the external camera workflow

If you wanted to configure your own camera, lens and bracket, here is some additional information you will need to understand the requirements.

Concept:

The camera must be mounted on the bracket so that the focal center (nodal point) of the camera lens is rotating about the center axis of the bracket and the height of the camera is set so that the optical center of the scanner matches the focal center of the camera. See image below:



The offset for either scanner is measured from the bottom of the Tribrach adaptor to the nodal point of the lens.

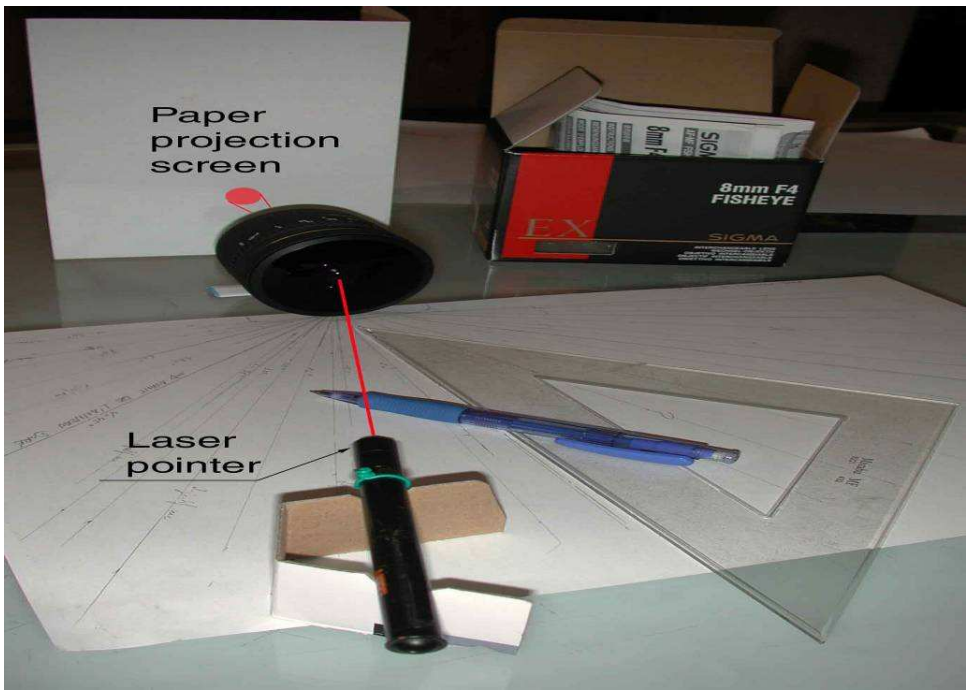
The nodal point of a camera body and lens combination needs to be determined in order to properly mount the camera in the bracket. In the image above, the offset for the lens is 20mm. Once the camera is set in the bracket and is rotating around the center of the bracket, the offset is applied (in this case 20 mm), and then the camera is positioned in the bracket to match the scanner used. In our kit both scanners need a machined bracket to make up for the height needed.

Follow the instruction in the bracket manual to set the camera on the bracket and then go to the web sites below to find the nodal point of your particular lens.

Go to:

http://michel.thoby.free.fr/SIGMA8mm/Alpha%20test%20300D/Nodal%20point%20of%20SIGMA%208mm.html

to find out how the nodal point of the lens used in this workflow was derived. Below is an image of how to find the nodal point of any lens using a compass and a laser pointer. Refer to the web site above for the procedure.



These are good web sites for understanding the stitching of photos to form a panoramic image:

http://stitcher.realviz.com/

http://stitcher.realviz.com/image-stitching-tutorials/stitching-tutorials/panorama-parallax-1.php

http://www.thegnomonworkshop.com/dvds/gdo01.html

These web sites are good resources for Nodal point location of various lenses:

www.hugha.co.uk/NodalPoint

http://michel.thoby.free.fr/SIGMA8mm/Alpha%20test%20300D/Nodal%20point%20of%20SIGMA%208mm.html

Download site for Camera workflow:

http://software.lgshds.com/public/camera/