Spherical Panoramas for HDS Point Clouds
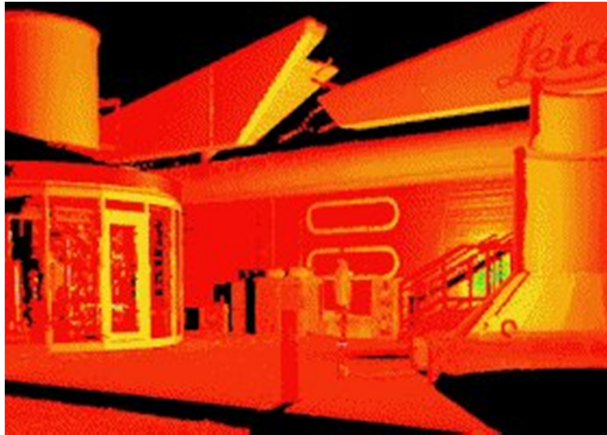
Spherical Panoramas for HDS Point Clouds

- **Why use Spherical Panoramas for HDS Point Clouds**

- **Taking the Photographs**

- **Creating the Equirectangular Images**

- **Creating the Cube Images**

- **Importing the Cube Images into Cyclone**

Why use Spherical Panoramas for HDS Point Clouds

- ■ **The colours of the points in the Point Cloud are determined by the intensity of the received reflected laser**

- ■ **This information is useful in its own right …**

- ■ **… but for some applications it is desirable to attribute the "natural" colours to the points**

Taking the Photographs
Choice of Lens

- **Just about any camera or camera lens combination could theoretically be used for taking the photographs, but the wider the angle of view the less images that are required**

- **Rectilinear (normal) lenses usually require many more images than Fisheye lenses, resulting in increased processing time and usually more user intervention adding additional Control Points and Optimising them**

Creating a full 360° Panorama using a Rectilinear (Normal) Lens in portrait format with an APS-C size Sensor							
Focal Length	35mm Equivalent	Number of Directions	Horizontal Angle Separation	Number of Planes	Vertical Angle Separation	Zenith Image	Total Images
10mm	15mm	8	45°	3	45°	Recommended	24
18mm	27mm	16	22.5°	4	35°	Not required	64 (56)
20mm	30mm	18	20°	7	30°	1	127
30mm	45mm	24	15°	9	20°	Recommended	216

Taking the Photographs
Choice of Lens

- **The much greater field of view of a Fisheye lens means that a much larger area of the subject is covered in the overlap between images giving PTGui's image matching algorithms a much greater chance of creating good Control Points**

- **The lens used in this guide is the Sigma 8mm as this is available in both Canon and Nikon fit, but there is a range of Fisheye lenses to select from, such as the lower cost Samyang 8mm**

Creating a full 360° Panorama using a Fisheye Lens in portrait format with an APS-C size Sensor							
	First Horizon			Second Horizon			
Lens and Focal Length	Vertical Angle from Horizon	Horizontal Angle Sep	Number of Directions	Vertical Angle from Horizon	Horizontal Angle Sep	Number of Directions	Total Images
Sigma 8mm	0°	60°	6	90°	90°	2	8
Sigma 8mm	10°	45°	8	90°		Recommended	8 (9)
Sigma 8mm	0°	45°	8	90°	90°	2	10
Nikon 10.5mm	0°	45°	8	90°	90°	2	10
Nikon 10.5mm	0°	45°	8	45°	90°	4	12
Nikon 10.5mm	-10°	45°	8	45°	90°	4	12

Taking the Photographs
Choice of Camera Lens Combination

- Using a Sigma 8mm lens with a 35mm format sensor will produce a full circle image requiring less photographs for the panorama, but does not make as much use of the sensor as using the lens with an APS-C sensor as found in most lower cost DSLR (Digital Single Lens Reflex) cameras

35mm sensor format

APS-C sensor format

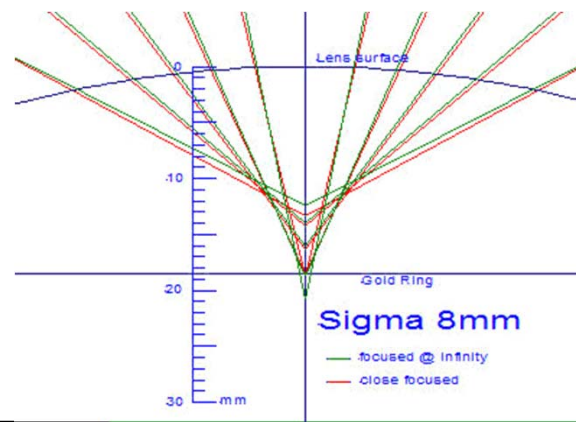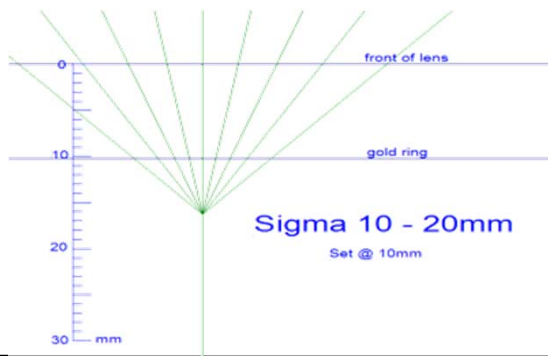# Taking the Photographs
Aligning the Camera

- **The axis of rotation must pass through the centre of the lens and the Nodal Point (entrance pupil)**

- **The height of the lens centre must match that of the Scanner**

Taking the Photographs
The Nodal Point (Entrance Pupil)

- **Some lenses have a single Nodal Point**

- **The Nodal Point in fisheye lense slides along the principal ray depending on the angle of incidence**

- **The Gold Ring on the fisheye lens is considered the best location for aligning the camera and lens with the axis of rotation**
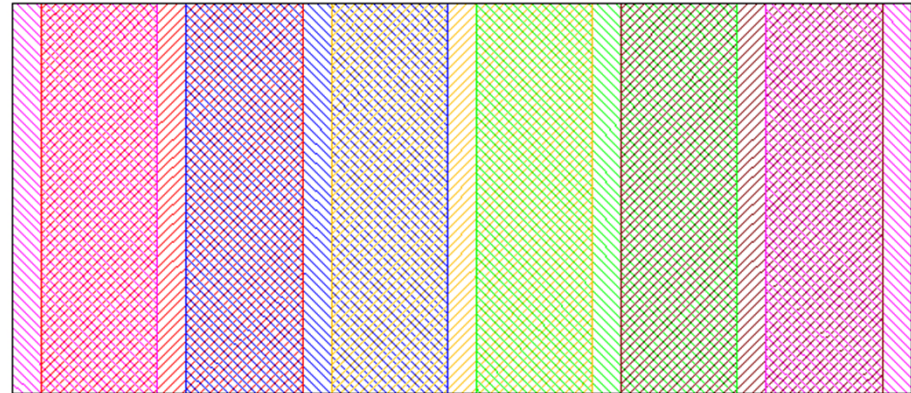
Taking the Photographs
How Many Photographs To Take?

- The greater the overlap between the images, the better the chance of PTGui being able to create good Control Points, but too great an overlap can cause problems, so a good rule of thumb is to aim for 40% to 50%

- The perceived wisdom and general advice is to use 6 images at 60° intervals with the Sigma or Samyang 8mm lens fitted to a camera with an APS-C sensor, which usually works, but can cause problems with both the image matching algorithms when creating the Control Points and Blending the images when creating the Equirectangular image

- 8 images at 45° intervals provides a greater overlap giving PTGui a better chance of producing good Control Points without any user intervention and enables the use of less of each image
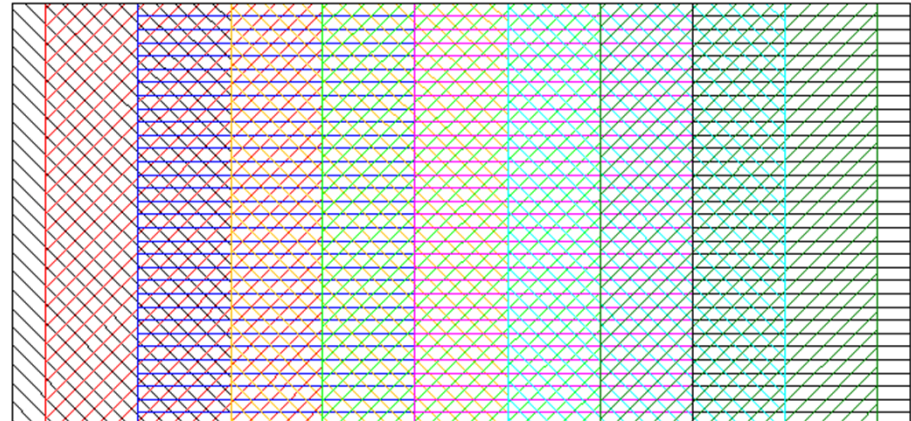
Taking the Photographs
How Many Photographs To Take?

- **6 images at 60° intervals**

- **Less overlap**

- **8 images at 45° intervals**

- **More overlap**

- **More images overlap**

Taking the Photographs
Camera Orientation

- Taking the photographs with the camera horizontal will result in a "hole" at the nadir, which can be filled with a "Tripod Cap" and the possibility of a "hole", or bad image matching, at the zenith, which can be eliminated by taking a couple of images to the zenith at right angles to each other

- Alternatively, the camera can be tilted upwards by 10°, which will increase the "hole" at the nadir, but not significantly, but which will eliminate the "hole" at the zenith, especially outside where much of the top part of the image will have little or no detail

- Tilting the camera up by 10° indoors can however cause problems, especially if there is a lot of detail in the upper part of the image

Horizontal

+10°

Taking the Photographs
Exposure

- PTGui is capable of blending images with different exposures

- The choice to let the camera select the exposure or to set the exposure manually will depend on the site conditions

- Letting the camera select the shutter speed and aperture will often produce good results, but it is important to consider the point at which the camera is measuring the exposure from

- In poor lighting conditions, such as in a room, the camera will usually select a wide aperture minimising the "depth of field", but it is likely that there is a large range in the distances of the subject from the camera so a greater "depth of field" is preferred, in which case setting the exposure manually will give the best results

- PTGui supports HDR (High Dynamic Range) imaging and experimenting with this technology is worthwhile

Taking the Photographs
Exposure

- It is important to ensure that the exposure is set for the subject of interest …

Taking the Photographs
Focus

- Using the camera/lens autofocus can result in the focus not being to the subject of interest so using manual focus, if available, is recommended

- Lack of detail at the point the lens is attempting to autofocus on will cause the lens to "hunt", which could result in a "soft" (out of focus) image or no image being recorded

- Fisheye lenses tend to have a large "depth of field", which increases as the aperture decreases, so a useful aperture should be selected

- e.g. An aperture of f5.6 with a Sigma 8mm lens with the focus set between 0.5 and 1 metre will give a "depth of field" of between 0.3 metres and infinity

Taking the Photographs
Tips when using a Sigma 8mm Lens

- **The lens cap on some lenses, such as the Sigma 8mm and Sigma 4.5mm, is in two parts – both must be removed otherwise the field of view will be restricted**

- **It is possible to focus many fisheye lenses, such as the Sigma 8mm lens, beyond the infinity position, which will "soften" the image, so it is worth checking the focus setting**

- **Use a remote trigger release if possible to avoid having to touch the camera, especially indoors where low available light can require long exposures**
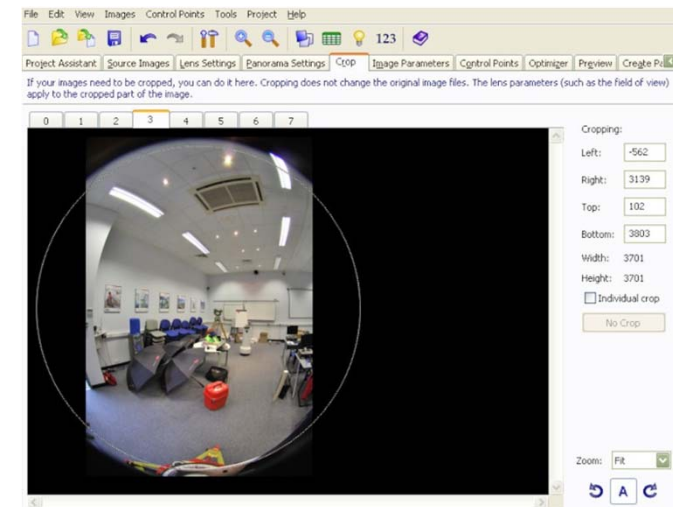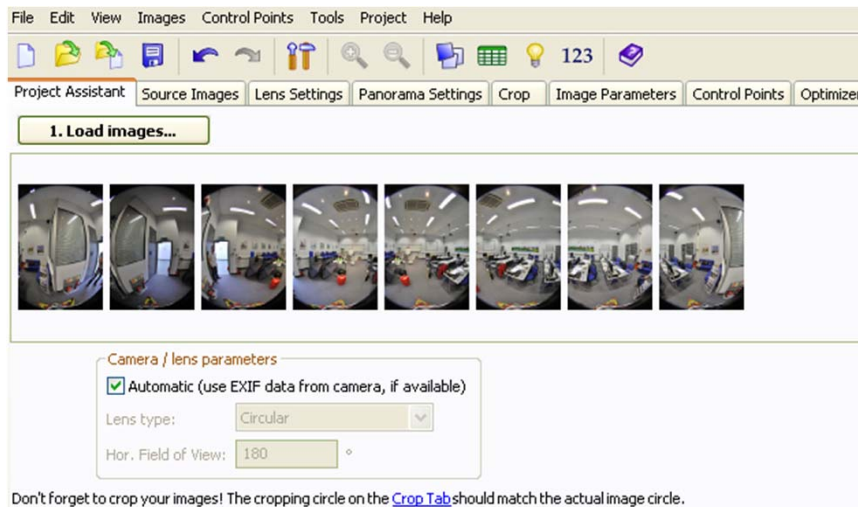
Creating the Equirectangular Images
Using PTGui

- **Launch PTGui - PTGui will load at the "Project Assistance" tab**

- **PTGui can be switched between "Advanced" and "Simple" mode when the "Project Assistance" tab is selected – using PTGui in "Advanced" mode provides more options and greater control**

- **It is recommended that PTGui uses the EXIF information held in the digital image, but it may be necessary to use the menu bar and select "Tools" \ "Options…" \ "EXIF" to ensure that PTGui will recognise the fisheye lens if one is used**

- **Click the "1. Load images..." button in the "Project Assistance" tab and import the images that make up the panorama**

- **Once the images have loaded, the "Crop" tab can be used to check that the images have been correctly cropped according to the EXIF information from the digital image**

Creating the Equirectangular Images
Using PTGui
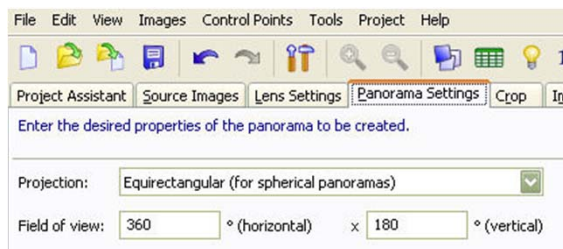
- Use the "Panorama Settings" tab to check the Projection: is Equirectangular and the "Field of view:" is 360° x 180°

- Click the "2. Allign images..." button in the "Project Assistance" tab and wait while PTGui creates the Control Points

Creating the Equirectangular Images
Using PTGui – Control Points

- **Control Points can be Edited, Added and Deleted by opening the "Control Points" tab**

- **If Control Points are Edited, Added or Deleted, select the "Optimizer" tab and click "Run Optimizer"**

- **In rare cases it may be necessary to Manually enter Control Points without using the "2. Align images…" option**

Creating the Equirectangular Images
Using PTGui – Create Panorama
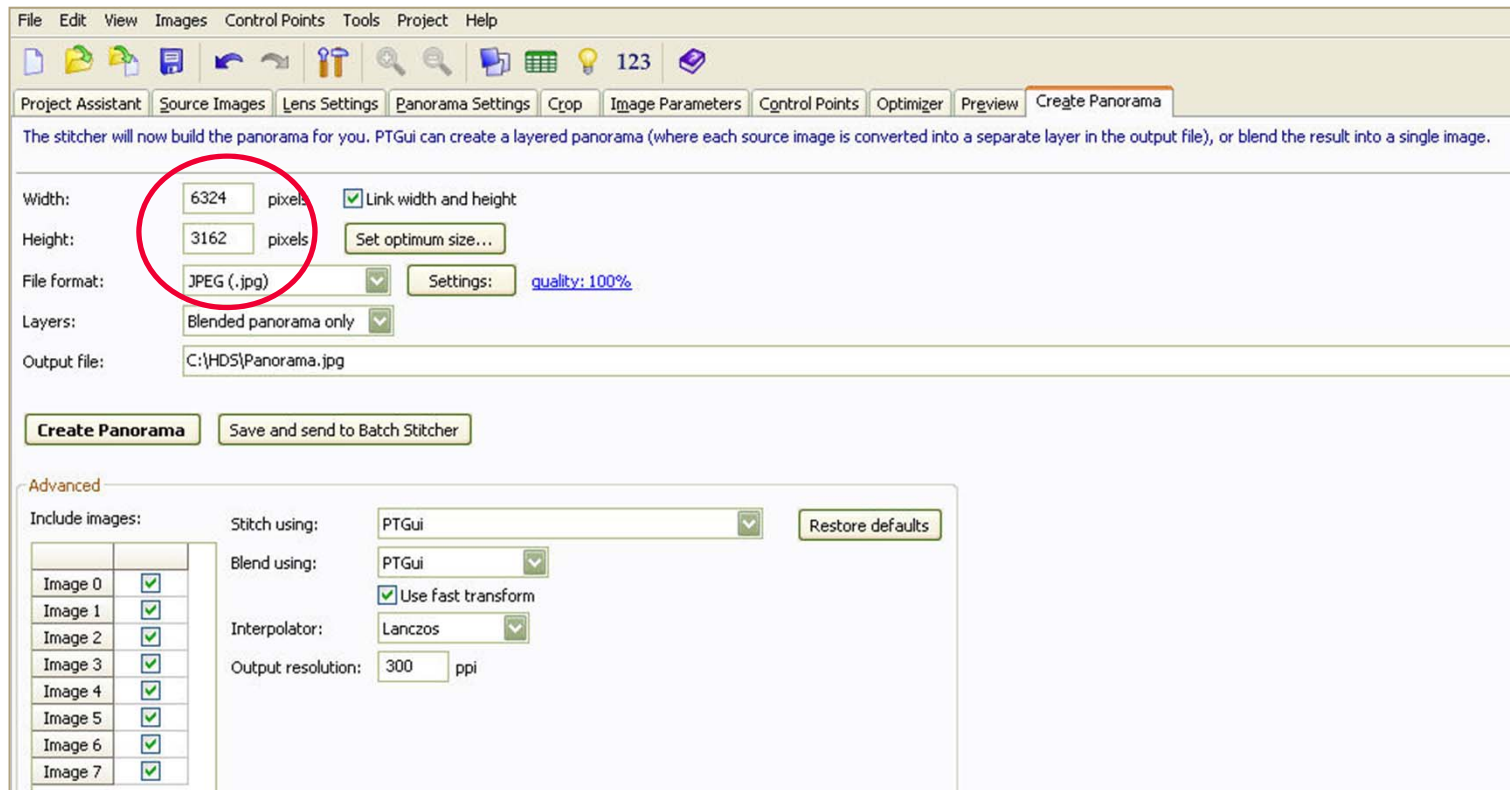
■ **Ensure that the "Width:" is exactly twice the "Height:" and the resolution is as required then click "Create Panorama"**

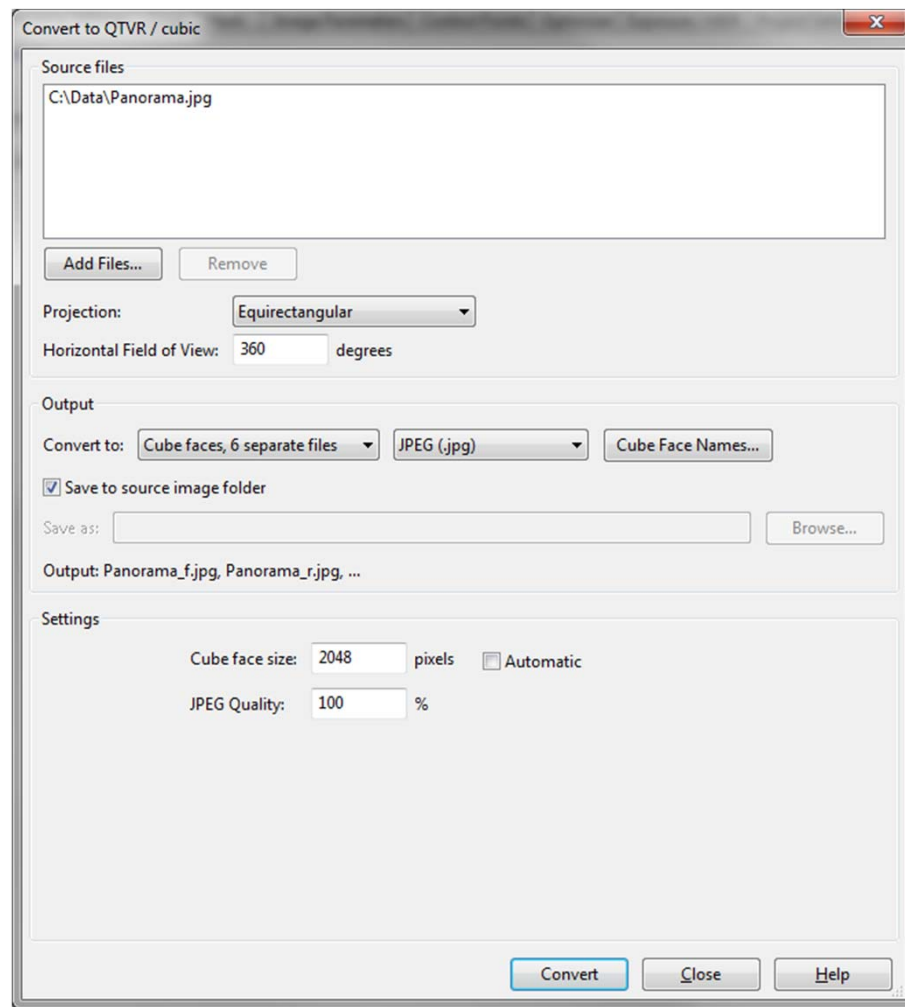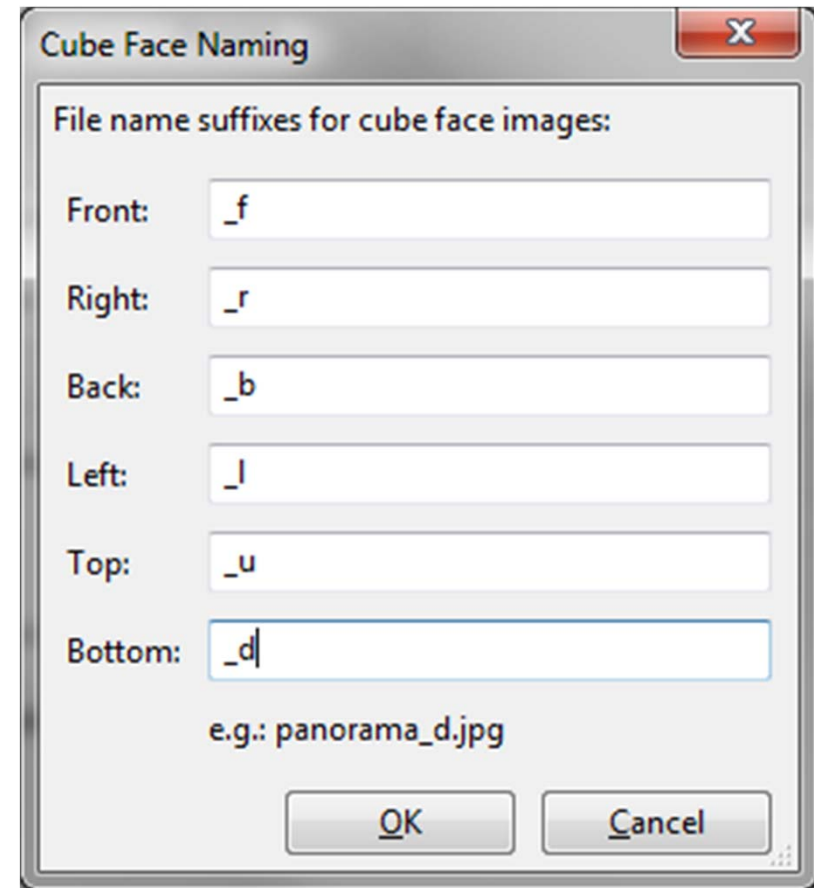# Creating the Cube Images
Using PTGui

- **The Cube Images required for importing the Spherical Panorama into Cyclone can be created using PTGui**

- **From the menu bar select "Tools" \ "Convert to QTVR / cubic…"**

- **Click the "Add Files…" button and import the Equirectangular image**

- **Select "Cube faces, 6 separate files" at the "Convert to:" option**

- **Uncheck the "Automatic" box and manually enter the "Cube face size:" value**

- **Cyclone can accept Cube sizes of 1024 x 1024, 2048 x 2048 and 4096 x 4096**

- **Set the "JPEG Quality:" to 100%**

Creating the Cube Images
Using PTGui

Creating the Cube Images
Using PTGui

- **Select "Cube Face Names…" at the "Convert to:" option and ensure they match the image shown here, which is the nomenclature used by Cyclone**

- **PTGui should default to this next time it is run**

- **Click "OK"**

- **Click "Convert"**

Cube Face Naming

File name suffixes for cube face images:

|	
Front:	_f
Right:	_r
Back:	_b
Left:	_l
Top:	_u
Bottom:	_d

e.g.: panorama_d.jpg

OK   Cancel

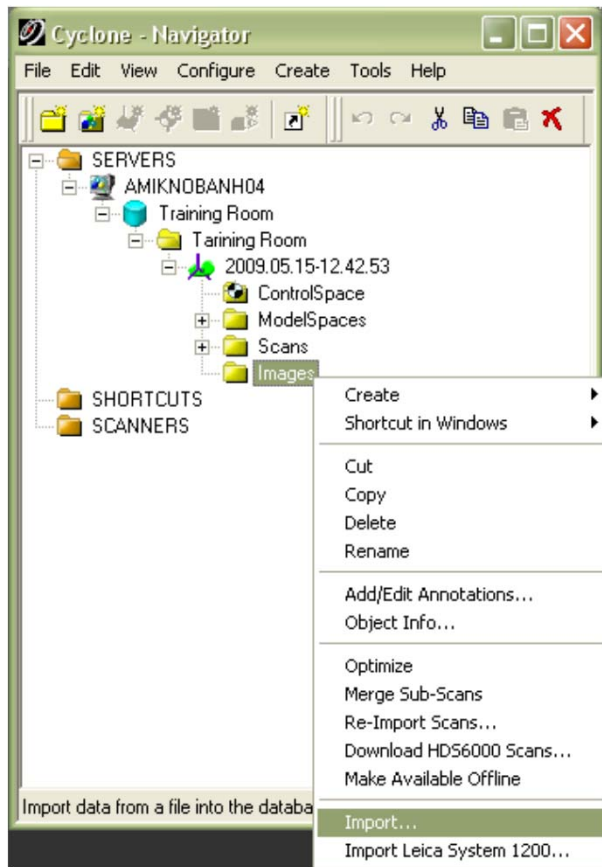# Creating the Cube Images
Using Pano2VR

- **Launch Pano2VR and click the "Select Input" button**

- **Click the "Open…" button for the "Panorama:" option and import the Equirectangular image**

- **At the "New Output Format:" option select "Transformation" and click the "+ Add" button**

- **In "Settings" at the "Type:" option scroll down and select "Cube Faces" and at the "Face Names:" option select 'f'..'d'**

- **In "Settings" at the "Image Size:" option enter 1024, 2048 or 4096 as Cyclone can only accept these Cube sizes**

- **In "Output" at the "Format:" option select "JPEG (.jpg)" and at the "Image Quality:" option select "100" for maximum quality**

Creating the Cube Images
Using Pano2VR
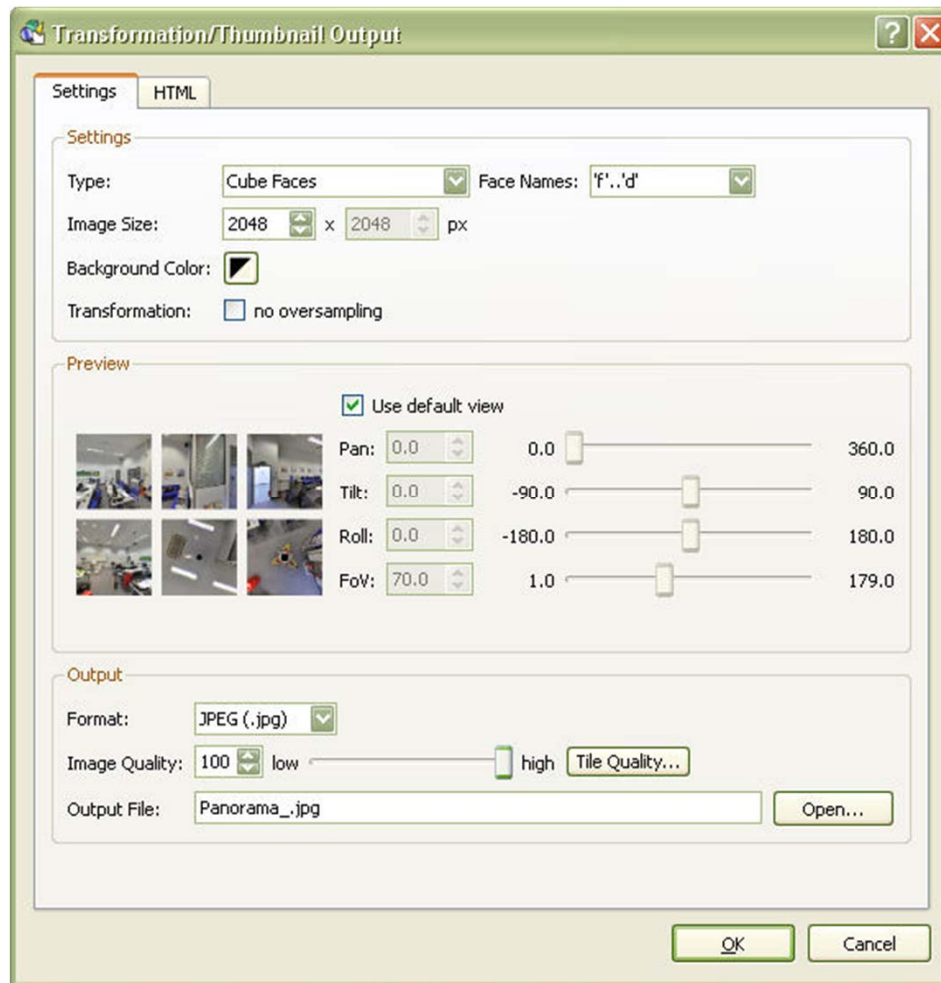
- **In "Output" click the "Open…" button to chose the location for the Cube Images and enter an "Output File:" name as *_.jpg with an underscore before the .jpg**

- **Click "OK"**

- **Click "Yes" at the "Create the output file '*_.jpg' now?" prompt**
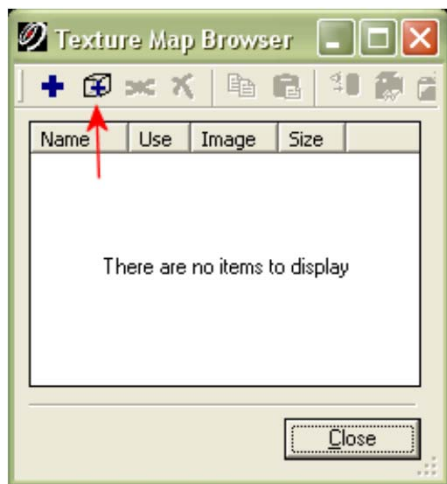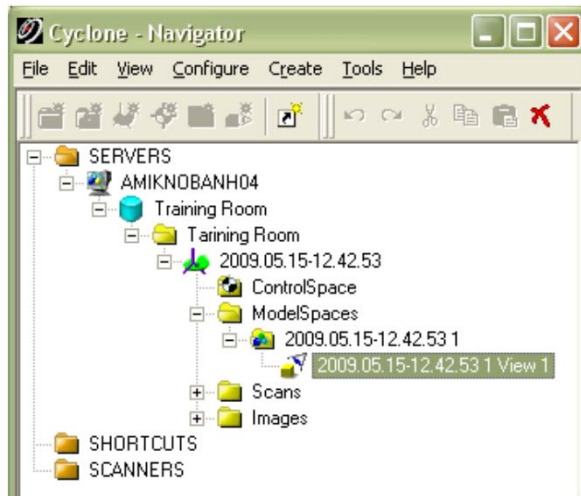
Importing the Cube Images into Cyclone

- **Open the Scan World, right click on the "Images" folder and select "Import…"**

- **Browse to the folder that holds the Cube Images and highlight all 6**

- **Click "Open"**

Importing the Cube Images into Cyclone

- **Open the Model Space containing the Point Clouds that are to be texture mapped**

- **Use the Pick Mode tool to select the Model Space to be texture mapped**

- **Select "Edit Object" \ "Appearance >" \ "Texture Map Browser…"**

- **Click the "Add Cube Map Images" icon on the "Texture Map Browser"**

- **Browse to and highlight the "Images" folder that contains the Cube Images in the "Select Project with Cube Map Images" panel**
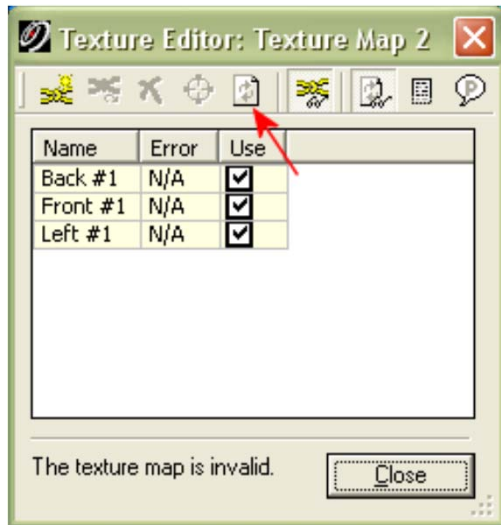
Importing the Cube Images into Cyclone

- **Click "OK"**

- **The "Texture Editor" together with the "Back Cube Image" should be displayed (This may take a few seconds, especially if 4096 x 4096 Cube Images are being used)**

- **Navigate in the Model Space to where the first Matching Point is to be selected**

- **Click on the Cube Image to select the Pick (Notice the "zoom" to enable accurate picking)**

- **Use the Pick Mode tool to select the same point in the Model Space**

- **Click the "Add Constraints" icon in the "Texture Editor:" panel**

Importing the Cube Images into Cyclone

Texture Editor: Texture Map 2

Name	Error	Use
Front #1	N/A	☑

The texture map is invalid.   Close
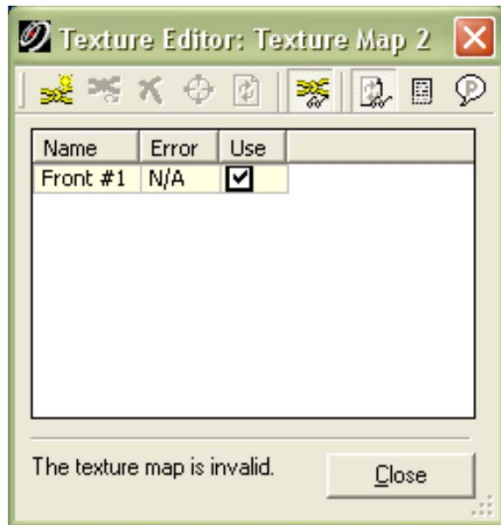
- **The Constraint is added to the Texture Editor: with the appropriate Cube Image name**

- **Right click the Cube Image to select a different one from the Menu as required**

- **Repeat the process by selecting a Pick in the Cube Image then in the Model Space for additional constraint Points (A minimum of three matching Picks is required)**

Importing the Cube Images into Cyclone

Texture Editor: Texture Map 2

Name	Error	Use
Back #1	N/A	☑
Front #1	N/A	☑
Left #1	N/A	☑

The texture map is invalid.　　Close

- **Once a minimum of three Picks are selected, the "Compute" icon will become live**

- **Click the "Compute" icon in the "Texture Editor:" when three or more points have been matched**

- **Close the "Texture Editor:" and "Texture Map Browser"**

- **Ensure that the "Global Texture Map" option in "View" is active**

- **Use the Pick Mode tool to select the Model Space**

- **Select "Edit Object" \ "Appearance >" \ "Apply Colour Map >" \ "Image Texture Map"**