

Making High Dynamic Range (HDR) Panoramas with Hugin

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Introduction

This document details how to use the free software programme Hugin (<http://hugin.sourceforge.net/>) to stitch together sets of bracketed JPEG images into one 360° HDR panorama. This can also be accomplished with Adobe CS5 (<http://unifiedphoto.com/2010/06/adobe-photoshop-cs5-hdr-tutorial-panorama-example/>) but the process is much quicker and easier with Hugin. Hugin is free, open-source and available for PC and Mac platforms. Hugin can be downloaded for Mac and PC at <http://sourceforge.net/projects/hugin/files/hugin/>. At the time of writing 2011.0 is the latest version. Stitching HDR panoramas can take a lot of computer memory, and with high resolution images, and there should be at least 4Gb of ram on host machine. The rest of this document assumes a PC host machine, although the Mac workflow is almost identical. The format of this document uses square brackets [] with two numbers inside to designate parts of the Hugin interface. The first number is the figure number in this document, and the second is the highlighted area within that figure. From the panoramic photography instructions detailed in the 'Taking HDR Panoramas' document, 12 (for three shot brackets), or 20 (for 5 shot brackets), JPG images should now be available for each panorama.

Lens Calibration

Hugin needs to know the characteristics of the camera lens to be able to make an optimal first guess at the image stitching. For this image calibration a set of bracketed shots of a test scene is required. The test scene should be an interior scene, or a scene with high contrast features covering most of the view i.e. without a large clear, empty sky or large monochrome ceiling, so that all of the images can be used for control point generation and stitching. Good calibration images at 2, 6 and 10 mega-pixel resolution are available from the resources section of the web portal.

These files need to be loaded these into Hugin. So the files must be available to the computer running Hugin (either on the hard drive or on memory stick). Hugin is started by clicking on the desktop icon and displays Hugin start screen (Figure 1). Hugin opens with the 'Assistant' [1.1] tab open where images can be loaded by clicking on the load images [1.5] button. Clicking on this button, and navigating to the calibration images, loads them into Hugin.

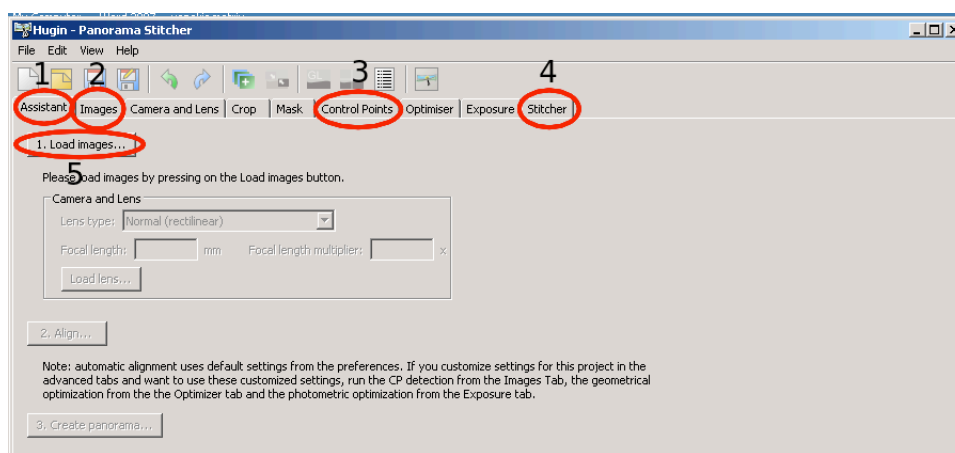


Figure 1: The main Hugin window

When the images are selected and the OK button is pressed Hugin will present the lens data window (Figure 2). When creating HDR panoramas the 'Load Lens data' [2.1] button would now be pressed, but as there is not yet a calibrated lens file to load approximate values should be entered into the boxes. In the Lens type box [2.2] 'Full frame fish-eye' or 'Stereographic' should be chosen if a full-frame fish-eye lens is being used; the choice ultimately depends on which gives the best image alignment during panorama creation. Focal length [2.3] should be the one stated for the lens e.g 8mm, and the focal length multiplier [2.4] is specific to the camera and is often 1.5. Giving this information allows Hugin to make a guess at the Horizontal Field of View HFOV value [2.5]. Click OK.

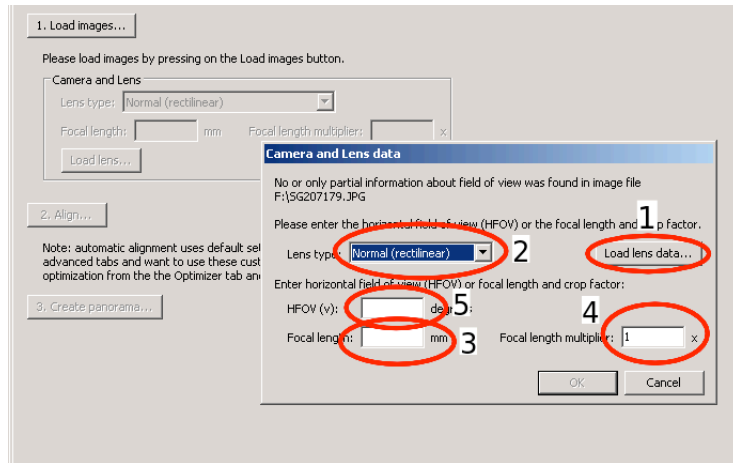
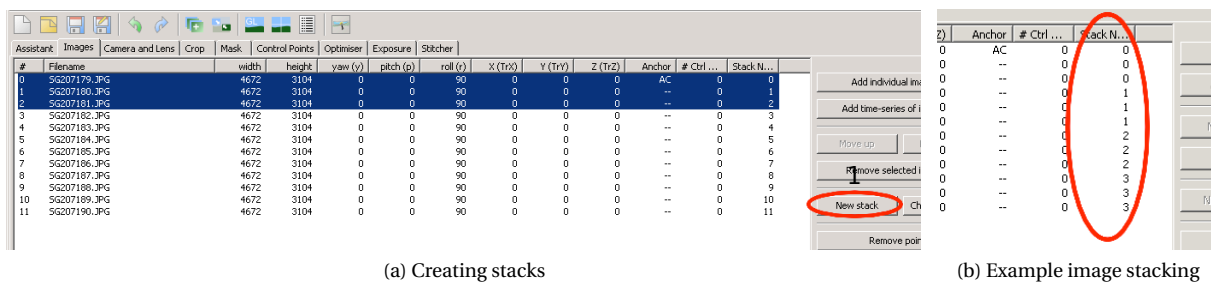


Figure 2: Lens data window

When back on the main screen on the tab next to 'Assistant' called 'Images' [1.2] there should be a list of the loaded images. Clicking on them brings up a preview below the list. Hugin now has to be told which images belong to one set of bracketed shots i.e. the shots that were taken in one direction. Hugin calls these sets of images 'stacks'. Select the first set of bracketed shots in the images list (either the first 3 or the first 5 depending on how many bracketed shots were taken in each direction) by shift clicking, and press the 'New Stack' button [3a.1] on the right.

For good lens calibration it is advisable to take more than the 4 sets of bracketed shots taken for general panorama creation, so there should be 5 or 6 stacks in total. Do the same for all stacks of images until the right most 'Stack Number' column looks like figure 3b.



(a) Creating stacks

(b) Example image stacking

Figure 3: Image stacks

Control points between the images now need to be created. Select the middle exposure image from each of the stacks by 'shift - left-clicking' them in turn. For three shot stacks that selection will look like figure 4.

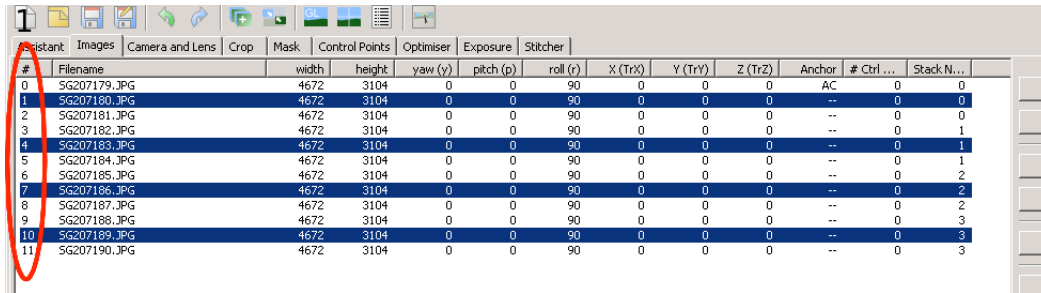


Figure 4: Selecting images for control point creation

Now press the 'Create Control Points' button below the list of images. Hugin will now try and find control points in the overlapping areas of the images and will tell you if it has succeeded when it is finished. If no control points were created it can be worth trying different point creation algorithms which can be selected from the drop-down menu. 'Hugin's CPfind' and 'Panomatic' are good options but 'Panomatic' does not come as part of the default Hugin installation. It can however be downloaded from <http://aorlinsk2.free.fr/panomatic/?p=releases>. Hugin must be told the location of the downloaded panomatic executable and this is done by going to 'Edit' - 'Preferences' - 'Control Point Detectors' and editing the entry for panomatic.

When control point generation has finished Hugin will display a message saying how many control points have been corrected. If there is good overlap between the images, and the scene was a dense, 360° high contrast scene, a good number of control points i.e. more than 20, should have been created. Now go to the 'Control Points' tab at the top to examine the created control points. From the drop down lists on both sides of the screen select the two middle exposure images from the first two stacks (Images numbered 1 and 4 in the left most '#' column [4.1]). The 'Control Points' screen should look like figure 5b. Quickly check the position of the control point pairs as sometimes errors are made during their generation. If a pair is in the wrong place they can be deleted from the list at the bottom of the screen [5b.1]. If there are no control points some can be created by clicking on a particular point in one image, which appears in the other image. When the image is clicked Hugin will zoom in on the image and you can fine tune the position of your point (figure 6). Then click on the corresponding point in the other image and fine tune the position of that control point to match up with the first. Click on the 'Add' button [5b.1] to accept the control points which will then appear in the control point list below the image windows [5b.2]. Make sure there are at least three, well spaced control points (one in the top and bottom corners and near horizon) between each image stack (figure 7). From the drop down lists next select the middle exposure images from the second and third stacks and do the same. Repeat for the subsequent until the last pairing between the last stack and the first.

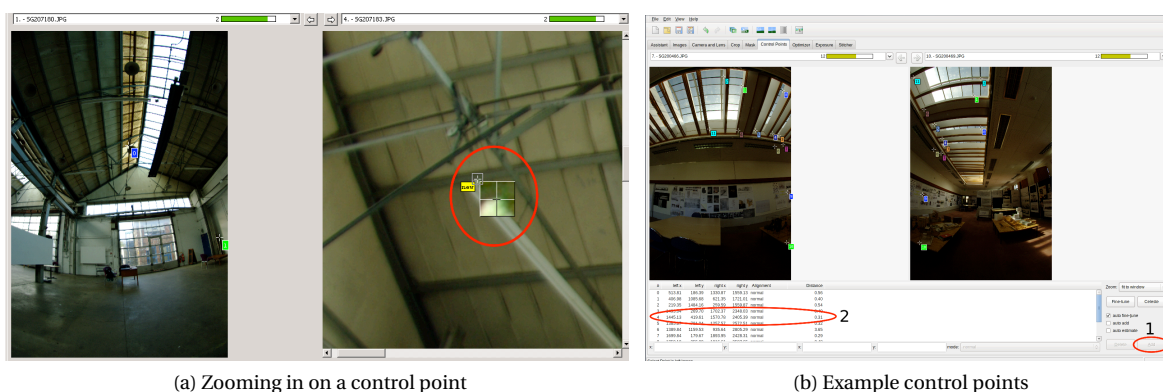


Figure 5: Control point creation

There should now be control points between each neighbouring sets of stacks. Go to the 'Optimizer' tab and from the top drop-down list make sure 'Positions (incremental from anchor)' is selected. Press 'Optimize Now'. Now select 'Everything without translation' and click 'Optimize Now' again. If it says that there are no control points between some images then re-examine your images in the control point tab to make sure that the

middle exposure images from each neighbouring stack have control points. Once alignment has finished open the preview window (figure 8). Hopefully the images are well aligned. If not try using a different lens projection e.g. 'Stereographic' instead of 'full frame fish-eye' or vice-versa with the lens option on the 'Assistant' tab and re-optimize, and/or going back to the main Hugin window and selecting 'View' – 'control point table' from the top menu. Delete and points that have a distance of over 100. If this removes a control point from an image overlap where there is no other, or only one other, control point, than manually recreate a new control point. Hit the 'Align' button on the 'Assistant' tab again and check the alignment in the preview window again. If the colours are distorted tick the 'Photometrics' box [61] on the top left of the 'Preview' tab in the preview window. If the panorama is a bit wonky go to the 'Move/Drag' tab [6.2] and click the 'Straighten' button.

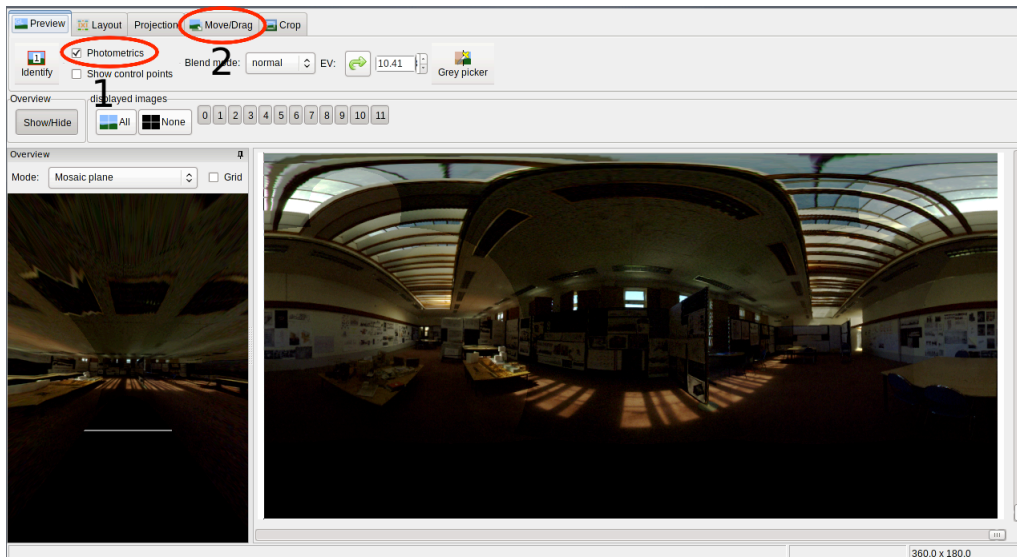


Figure 6: Preview window

If you are happy with the alignment then go to the 'Exposure' tab in the main Hugin programme and select 'Custom parameters below' from the top drop down menu. De-select 'Exposure' and 'White balance' variable by clicking the cancel button below the respective lists. Select 'Vignetting' and 'Camera response' and press the 'Optimize now' button. Finally, go to the 'Camera and lens' tab in Hugin and select one of the images. On the right of the window click the 'Save lens' button and save the lens calibration file. These files are specific, not only to the camera and the lens, but also to the photo resolution. The Samsung-gx20 has 4 possible resolutions (2, 4, 6 and 14.7 mega-pixels). A lens calibration file has been created for each of these resolutions and is available from the resources section of the web portal along with a set of images that can be used for calibration.

Panorama Creation

The process of panorama creation is very similar to lens calibration except:

- A lens calibration file can now be loaded into Hugin when the images are loaded.
- Fewer control points are required; two per overlap minimum.
- Only a 'Positions (incremental from anchor)' positional optimisation should be required
- No exposure optimisation is required.

When a good alignment has again been achieved select the 'Output', 'Processing' and 'File Formats' options from the 'Stitching' tab as in figure 7 and press 'Stitch now' [7.1].

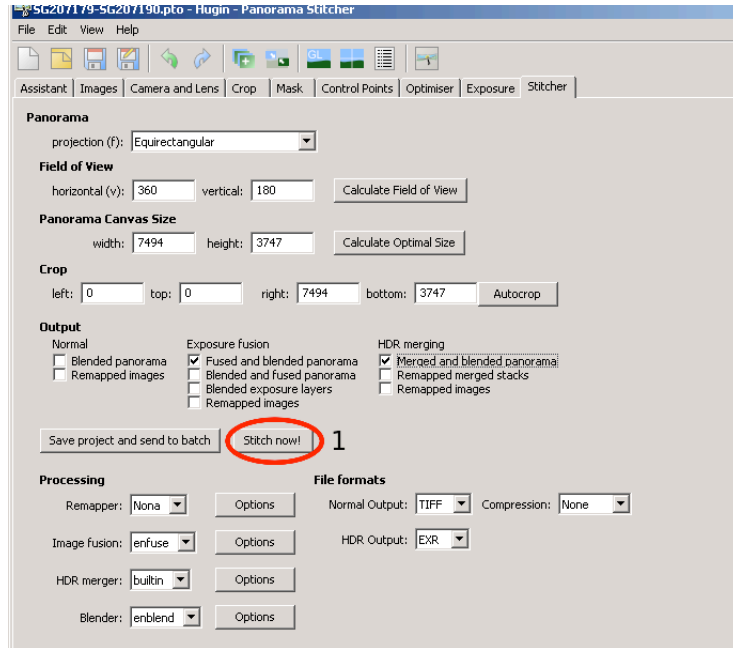


Figure 7: Final stitch window

Select the name and location for the stitched panorama to be saved to. Do NOT pick the memory card you have the original images on as it run out of space as large temporary files are created. The process will take a while but you should at the end have two files: a regular low dynamic range image panorama with a .tif extension, and an HDR panorama with an .exr extension. Both can be checked in PhotoShop. When checking the .exr file in Photoshop you may need to move the slider below the image to alter the exposure and see the image correctly. The .exr file is in lat-long format that can be used in various rendering programs. See the 'Using HDR Panoramas' document for more details.