

LensFix & PanoTools Plug-ins for Photoshop CS3 on OS X

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About PanoTools Plug-ins

The PanoTools plug-ins are a set of image correction and remapping plug-ins originally created by German mathematics professor Helmut Dersch. The original PanoTools plug-ins consisted of Correct (for correction of lens distortions), Remap (for converting between image types e.g. fisheye, rectilinear, mirror ball, etc.), Adjust (for extracting and inserting images in and out of a scene) and Perspective (for changing the apparent view of an image). The original plug-ins only worked on Classic Mac OS and Windows, were not actionable in Photoshop and only worked on 8 bit images. Our incarnation of the plug-ins are fully scriptable and work on 8 and 16 bit images. In addition, our new LensFix plug-in improves on the Correct plug-in by providing the user an intuitive graphical interface for setting and fine tuning correction factors and includes a database of pre-determined settings for many camera and lens combinations. These Panotools plug-ins work in Photoshop CS3 and later.

Minimum System Requirements

Mac OS X.4 or later, Photoshop CS3 and later.

Installing LensFix with PanoTools Plug-ins

Basic Installation:

1. Place the **PanoTools Plug-ins** folder inside the ~/Adobe Photoshop CS3/Plug-ins/Filters folder. Launch the Adobe Photoshop CS3 application.
2. **Install fovCalculator (optional).** Move the fovCalculator folder to your applications folder. fovCalculator is a handy application to calculate the number of images needed to make a panorama and the field of view of your lens and is useful for calculating input values for the Adjust and Remap filters. See the Adjust and Ramap filters for more information.
3. Copy the PanoTools User Manual to a location you can easily locate when needed.

Uninstalling PanoTools Plug-ins

If you've tried PanoTools plug-ins and decided it's not for you, it's very simple to uninstall. Drag the items you installed above to the trash.

Plug-in Features

Each of the plug-ins have their own specialty though there is some feature overlap. Below is a general overview of the plug-ins. Specific features of each plug-in are described later in this document.

Adjust -- for inserting and extracting images into and out of a panoramic view.

Correct -- for applying shear, radial luminance, scale etc. to the image. LensFix replaces Correct as the preferred method for correcting lens distortion.

LensFix -- is an improved interface for correcting lens distortions and includes a database of pre-determined correction factors.

Perspective -- for changing the viewing angle of the image as if the camera was pointed in a different direction. Perspective simulates a shift lens in software for normal and fisheye lenses.

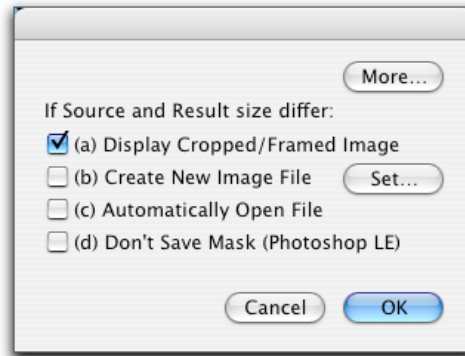
Remap -- for remapping an image from one projection to different projection. Not all projection changes are supported by PanoTools.

Using PanoTools Plug-ins

Preferences

The original plug-ins (Adjust, Correct, Perspective and Remap) share a common preference window. Some PanoTools transformations produce images that are larger or smaller than the source image. Because Photoshop does not allow plug-ins to resize images, the user is given the option to either display the result in a cropped or framed box (option a) or to create a new image file (option b). If option (b) is selected, you can choose to automatically open the file by selecting option (c). Select option (d) if you don't want masks saved in the PSD file. Note that Photoshop Elements 2 for OS X supports masks so the (d) option has little value. Typically, option (a) is selected for simple correct actions while options (b) and (c) are selected for image remapping options.

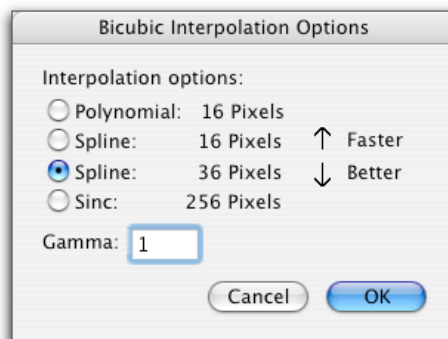
Important: Either option (a) or (b) must be checked before using any of the plug-ins. If you do not select (a) or (b), the plug-in will run but the results will not be displayed or saved.



Preferences > More...

Pressing the "More..." button on the first preference pane displays the interpolation options for the plug-ins. Interpolators determine how the next pixel looks when adjusting the image. PanoTools uses higher quality interpolators than available in Photoshop. The Polynomial option is similar in quality to Photoshop's BiCubic. Interpolators nearer the bottom of the list are higher quality. The speed of Polynomial, Spline 16 and Spline 36 are approximately the same, however the Sinc 256 interpolator is significantly more processor intensive than the first three options. For this reason, Spline 36 is generally a good all around choice for quality and performance.

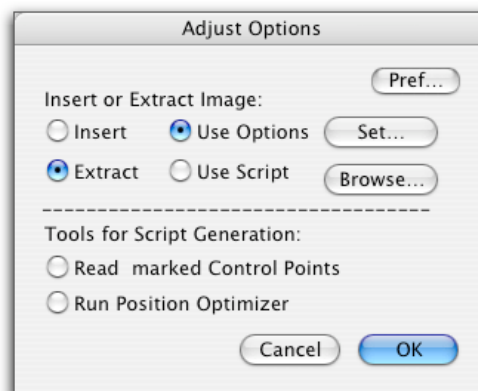
Gamma adjusts the brightness of the image during re-mapping. Generally it is not a factor you need to adjust when adjusting photographic images and should be set to 1.



Adjust

The Adjust filter is the most complicated filter of the set and was the original way to create panoramas using PanoTools. With the introduction of PTMac, there is an easier way to create panoramas. However, Adjust is still useful for extraction of partial images from panoramas. As only but the most hard core users will use Adjust for anything but extracting partial images from existing panoramas, we will focus on this aspect of Adjust.

The first window you see when selecting Adjust is a window requesting you tell the filter some basic information such as if you want to insert or extract an image.



The options on in this window want to know if you are inserting or extracting an image and if you want to use options or use a PanoTools script. Ignore the settings shown in the window. We want to select the Extract and Use Options selections to extract a normal (rectilinear) image from a spherical panorama. **Important: When extracting an image from a panorama, select options (b) and (c) (create new file and automatically open file) from the preferences window.** After selecting Extract and Use Options, press the Set button to bring up the main window shown below.

Options for Insert/Extract

Image:

HFov: 112 °

Format: ☒ Normal

☐ Cylindrical

☐ Fisheye fullfr.

☐ Fisheye circ.

☐ PSphere

Correct...

Position:

Yaw: -180°...+180° 35

Pitch: -90°...+90° 0

Roll: 0

Panorama:

HFov: 360 °

Format: ☐ Normal

☐ Cylindrical

☒ PSphere

Save to Buffer

Stitching:

☐ Load Buffer

Color Adjustment:

☐ and Paste

☐ Image

☒ or Blend

☐ Buffer

☐ both

☒ none

Feather: 10

Cancel

OK

For this example, we will extract a 112° wide image from a spherical (PSphere or equirectangular) image. A 112° wide image is the same view you would get if you were using a 12mm lens on a 35mm film camera. Chances are, such a short lens is not available for your camera. The top half of the window describes the image to be extracted or inserted while the bottom half of the window describes the panorama that is being created or edited. Specifically, the top half of the page notes we are extracting an image 112° wide and has a pixel dimension of 600 x 400 pixels. The vertical field of view is automatically calculated. The Photo will be a normal (rectilinear) image and will be extracted facing 35° right of the center of the panorama (yaw). The pitch (up and down) of the image is zero degrees (looking straight forward) and there is no roll to the image.

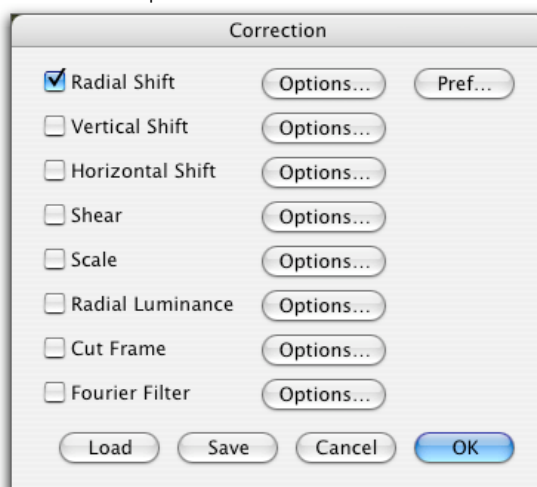
The panorama is a 360° spherical (PSphere or equirectangular) panorama that is 2400 pixels wide and 1200 pixels tall. The height and width of the panorama is not required when extracting an image from a panorama. The stitching options are also not needed as we are extracting an image. The source panorama and the resulting extracted image are shown below:





Correct

The Correct filter is the original lens distortion correction filter. Most of the functions of Correct have been moved to the new LensFix which provides a much improved user interface and a database of pre-determined lens correction factors. See LensFix for details of the Radial Shift, Vertical Shift, Horizontal Shift, Shear and Radial Luminance filter options.



The options Scale, Cut Frame and Fourier Filter found in the Correct plug-in were not incorporated in to LensFix. These options were seldom used. Here is a description of those options:

Scale: Scale allows the user to resize the source image using PanoTools' state-of-the-art interpolation algorithms. To use Scale, check the scale box then press the associated Options... button. Enter the desired dimensions of the new image. To preserve proportions, use the same width to height ratio as the source image. Scale is useful for upsizing images but may not be a desirable option for downsizing images as it does not contain an anti-aliasing feature.

Cut Frame: Cut Frame is an automatic cropping tool. To use Cut Frame, check the Cut Frame checkbox then press the associated Options... button. Enter the desired width and height of the image. Cut Frame will search the entire image for the brightest rectangle with these dimensions and remove the excess image around the brightest rectangle. Be sure to enable Preferences (b) "Create new image file" and (c) "Automatically open file" in the Preferences pane since this tool changes the size of the image.

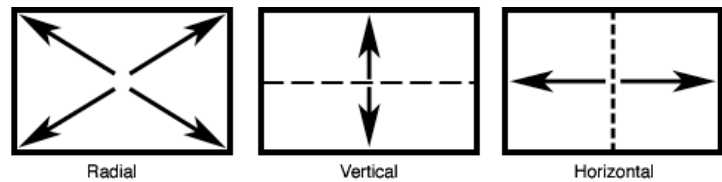
Fourier Filter: The Fourier filter applies a two dimensional fast Fourier transformation to the image. This function is incomplete.

To correct for distortion (barrel, pincushion, and wavy line) and chromatic aberrations, Correct calculates the new location of each pixel based on the fourth order polynomial given below.

$$r_{\text{source}} = a \cdot (r_{\text{dest}})^4 + b \cdot (r_{\text{dest}})^3 + c \cdot (r_{\text{dest}})^2 + d \cdot (r_{\text{dest}})$$

Where r_{source} is the location of the pixel in the source image and r_{dest} is the new location of the pixel in the corrected destination image. Without going in to the details, this gives LensFix the ability to correct for most types of lens distortions by adjusting the locations of individual pixels. Coefficients can be adjusted for each color channel by pressing the Individual controls button and thus also correcting chromatic aberrations.

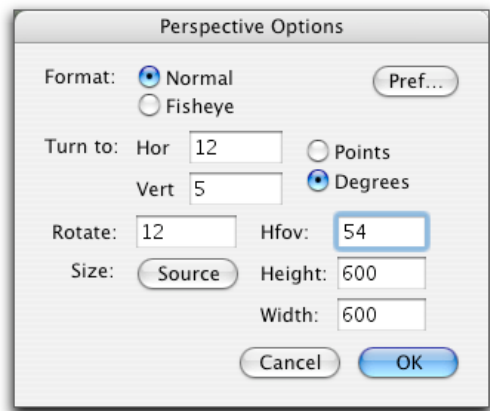
Three correction modes are offered.



Radial correction will expand or contract the image in all directions from the center. Vertical correction expands or contracts the image vertically from a central horizontal line. Horizontal correction expands or contracts the image horizontally from a central vertical line. The center of the correction location can be altered via the Image Shift option.

Perspective

Perspective allows the user to change the viewing angle of the image as if the camera was pointed in a different direction. Perspective simulates a shift lens in software for normal and fisheye lenses. Changing the viewing angle of an image is different than moving it along a blank canvas in your image editor. Moving an image left or right in Photoshop is like changing your viewpoint by stepping sideways along a wall. Turning the image using Perspective is similar to turning your head to get a different view.



The options for Perspective are straight forward. In Format, Normal refers to the type of image you get from standard camera lenses whereas in a Fisheye image, straight lines appear curved. If you are in doubt, chances are you have a Normal image.

The "Turn to" option tells Perspective how much to turn and rotate the image. Horizontal changes can be made from -180 to 180 degrees where negative values indicate a turn to the left and positive values indicate turns to the right. However, since your image probably has a Horizontal field of view (Hfov) of less than a complete circle (360 degrees), you will want to limit your changes to a few degrees. The same is true of vertical (Vert) changes. In this case, 90 degrees represents straight up, zero straight forward (unchanged) and -90 degrees is straight down. Rotation values can be any value. Positive values rotate the images counter clockwise and negative values rotate the image clockwise. A value of 90 degrees turns an image so the top becomes the left side etc.

Hfov refers to the horizontal field of view of your image. By horizontal field of view, we mean the field of view along a horizontal line in your image. For most users this is the most difficult setting to estimate. However, chances are your camera's documentation will give you the 35mm film camera equivalent focal length. You can convert that focal length using the below table to get a reasonable estimate of the horizontal field of view of your image:

"35mm film camera" lens equivalent in mm	Landscape Hfov	Portrait Hfov	Diagonal fov
12	112	90	121
14	104	81	114
16	97	74	107
18	90	67	100
21	81	59	92
25	71	51	82
30	62	44	72
35	54	38	63
40	48	33	57
45	44	30	51
50	40	27	47
55	36	25	43
60	33	23	40
65	31	21	37
70	29	19	34
75	27	18	32
80	25	17	30

To use the table above, check your camera's documentation. You should see something like "Camera lens focal length 7 to 43mm (28 to 172mm equivalent). Using this, we calculate a "focal length multiplier" by:

focal length multiplier = (camera specification 35mm lens) / (camera specification actual focal length)

For our example:

focal length multiplier = $28 / 7 = 4$ (alternatively, we could have used the longer numbers $172 / 43 = 4$).

The focal length multiplier will stay the same for your camera. You only need to calculate it once.

Then check the EXIF information of your photograph in the image editing program you are using (Graphic Converter, Photoshop, etc.) for the focal length of the image. This will usually be given as the actual focal length of the lens at the time of the photograph. The 35mm film camera equivalent is:

Equivalent 35mm film camera focal length = (EXIF focal length) x focal length multiplier.

For this example, we will use 9mm as the value given in the EXIF information. The equivalent "35mm film camera" focal length is:

Equivalent 35mm film camera focal length = $9 \times 4 = 36\text{mm}$

We now can look up the horizontal view from the above table. The closest value we have is for a 35mm lens which shows the field of view of the image along the long side (landscape) is 54° and that along the short side (portrait) is 38° .

Alternatively, you can use fovCalculator included in this download. For fovCalculator, simply enter the focal length and your camera's focal length multiplier and press the return key. Then check the landscape and portrait field of view listed for the rectilinear (normal) lens.

Getting EXIF information:

In Photoshop, go to File > File Info. Then choose EXIF in the Section pop-up list.

In GraphicConverter, go to Window > Show Information then press the EXIF tab.

Finally, enter the Height and Width of the resulting image. If you press the Source button, the size of the result will be equal to the size of the source image. Otherwise, enter the new size. Note, if the new size is different than the source size, you must select option (b) from the preferences (Create new image if the size of the result differs from the source).

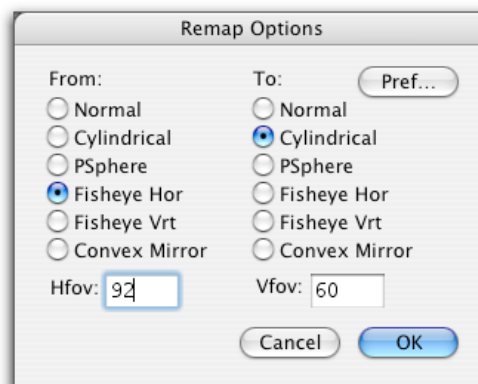
Remap

The Remap plug-in is a simple way to convert between many common image projections. A common use for Remap is to convert fisheye images in to normal(rectilinear) images. Supported image formats include:

- Normal - A normal image (also referred to as rectilinear) is the image type produced by standard camera lenses. In such images, square features appear square (instead of having curved sides). Note that image size increases dramatically beyond a 110° viewing angle. A 14mm lens on a typical 35mm camera has a 104° degree horizontal field of view.
- Cylindrical - Cylindrical images are produced by scanning cameras and are the original QTVR format. Cylindrical images are also produced by most panorama stitching programs such as PTMac. The practical vertical field of view for cylindrical panoramas is approximately 160° degrees. If you are going to make a panorama having more than 140° degrees field of view, you should consider using the PSphere (equirectangular) format. Cylindrical panoramas cannot show the very top or bottom of a scene.
- PSphere - PSphere is short for Photo Sphere and is also referred to as the equirectangular format. A full $360^\circ \times 180^\circ$ degree equirectangular image shows every view of a scene including straight up and down views. Equirectangular images are often converted to Apple's cubic QTVR format or viewed using the PTViewer Java applet.
- Fisheye Hor - Fisheye Horizontal is the type one would get when taking a photograph using a fisheye lens pointed towards the horizon. Fisheye lenses produce images where straight lines not directly passing through the center of the image will appear curved.
- Fisheye Vrt - Fisheye Vertical is the vertical equivalent of fisheye horizontal except that the apparent camera orientation is vertical.
- Convex Mirror - Convex mirror is what you would see when looking at a mirror ball. Mirror ball reflections show the nearly entire scene with the exception of the area behind the ball.

Using Remap

Using Remap is straightforward. Select the input image type from the list on the left and the desired output type on the right. Enter the input image's horizontal field of view in the appropriate box. Generally, the vertical field of view is disregarded.



One of the more popular uses of Remap is converting full frame fisheye images to the normal format. The field of view given by most lens manufacturers is the diagonal field of view. For a 35mm film camera, full frame fisheye images cover approximately 180 degrees diagonally. The same lens on a digital SLR where image sensor is smaller than a standard film based camera is correspondingly smaller. Here are some typical horizontal field of view settings for a full frame fisheye lens (15 or 16mm):

Canon D30, D60, 10D, Digital Rebel (300D) 1.6x focal length multiplier
Horizontal field of view in portrait mode 57°. Landscape mode 86°

Nikon D100, Fuji S1, Fuji S2; 1.5x focal length multiplier
Horizontal field of view in portrait mode 61°. Landscape mode 92°

The following conversions are available in Remap:

Normal to:

- Cylindrical
- PSphere
- Fisheye Horizontal (for Fisheye Vertical use Fisheye Horizontal then the Perspective plug-in)

Cylindrical to:

- Normal
- PSphere
- Fisheye Horizontal

PSphere to:

- Normal
- Cylindrical
- Fisheye Horizontal
- Fisheye Vertical

Fisheye Horizontal to:

- Normal
- Cylindrical
- PSphere

Fisheye Vertical to:

- Cylindrical
- PSphere
- Convex Mirror

Convex Mirror to:

- Cylindrical
- PSphere
- Fisheye Vertical

Purchasing PanoTools for OS X

PanoTools for OS X is distributed as shareware. This means that you may evaluate it free for 15 days, but if you continue using it beyond that time, you must purchase a license for \$39.95 (US). After paying for your copy, you will receive upgrades and technical support, as well as a code to enable the plug-ins. The full text of the license agreement is included in the plug-ins folder. Please make sure you have read it and agree to its terms.

Technical Support

The latest news, technical support answers, and updates can be found on our Web Site at:

[<http://www.kekus.com>](http://www.kekus.com)

Please send any comments, bugs, or technical support questions to us at:

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Limitations

Image processing for the plug-ins is performed by the open source PanoTools.bundle. The source code for the PanoTools.bundle is available on SourceForge and on our Kekus.com web site.

Thanks

Thank you for purchasing our plug-ins.

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Change History

Version 4.0 (December 3, 2007):

What's new:

- Universal binary version compatible with Photoshop CS3 and later on OS X.4 and later.

Version 3.0.2:

What's new:

- Fixed Adjust bug that caused incorrect results if distortion correction used while playing back a Photoshop action.

Version 3.0.1:

What's new:

- Fixed bug that caused LensFix to crash for new users in Photoshop when loading a database.

Version 3.0:

What's new:

- Improved vignetting correction method. Vignetting correction is now done within LensFix.
- Improved script reliability in Photoshop.
- Added the ability to browse to databases not in the predefined locations.
- Modified 16 bit image correction so 15 bit to 16 bit conversion occurs in the plug-ins and not the Panotools bundle. The change requires use of PanoTools.bundle 2.7KK24 and later. The change improves 16 bit support in PTMac.

Version 2.0.20:

What's new:

- Added a French LensFix and manual. Merci Hervé Godin.
- Updated PanoTools bundle to version 2.7KK23
- Included additional lens correction settings

Version 2.0.19:

What's new:

- Added a revert button to LensFix so users can easily return the preview to show the original image.
- Updated the Remap plug-in to version 1.3. New images are now created (if desired) for each image when run as an action. Allows for batch conversion of fisheye images to normal images.
- Updated the Adjust plug-in to version 1.3. Adjust now creates a new image for each image when processed in batch mode. Behavior is similar to Remap.
- Included a sample action for remapping fisheye images to normal images.

Bug fix:

- Fixed action recording and playback for LensFix. Actions can now be created that apply a single set of correction factors to a set of images or can best find settings from the database.

Version 2.0.18:

What's new:

- Revised database format so multiple cameras and manufactures can be associated with a single lens. Digital SLR type cameras with the same sensor size can now share settings of a single lens.
- Interpolation option added so intermediate settings of zoom lenses can be estimated from existing data.
- Added new preference options to support give the user the ability to choose between creating a script using the same settings for each processed by the action or to have LensFix search for the best setting and interpolate if necessary.
- Lens database names can now include special characters such as -, @, etc.
- Included an updated PanoTools.bundle that fixes a bug where the Correct or LensFix filters will apply the wrong settings if different distortion correction settings are used for each color channel. The bug also affects the Windows version of Correct.

Version 2.0.12:

What's new:

- Lens databases can now be edited in TextEdit, BBEdit or Property List Editor and used in LensFix.

Version 2.0.11:

What's new:

- Included updated database with additional camera and lens support.

Bug Fix:

- Fix bug that crashed Photoshop when attempting to add a new lens into an empty lens database.

Version 2.0.10:

What's new:

- Reading EXIF tags and automatic search for the appropriate lenses in available lens databases based on the EXIF focal length value
- Pop-up menus for camera vendors and models added in lens settings editing window. To add new vendors and models file MenuTemplates.xml (located in Resources folder inside of plug-in bundle) can be edited manually.
- Displaying of camera vendor, model and lens' focal length on the bottom of main LensFix window
- XML format for lens databases implemented; old databases get automatically converted to XML when any lens is opened and saved with the new plugin
- State of Autoupdate preview checkbox can be saved now. The Autoupdate state is saved as the value when LensFix applied to an image. For example, if you apply LensFix with Autoupdate off, the next time you launch LensFix, Autoupdate will be off and vice versa.

- New preference added for automatic detection of the best lens settings

Known issues:

- GraphicConverter does not provide appropriate callback and LensFix cannot read EXIF information from images in it.
- EXIF information may not be read from RAW images if you are using the RAW plug-in that came with Photoshop CS. This is because the original Photoshop CS RAW plug-in does not pass EXIF info to anything but JPEG files. Solution: Download the latest version of the Photoshop RAW plug-in from the Adobe site.

Version 2.0.9:

- Fixed some conflicts with third party Finder add-ons such as Default Folder that caused LensFix crashes in Photoshop CS.
- Included updated LensFix database.

Version 2.0.7:

- Modified PanoTools.bundle search path so installation is now be drag and drop and drop in to the host applications filter folder.
- Included this user's manual.
- Modified lens database search path.
- Increased size of yaw, pitch and roll input boxes in the Adjust filter to allow for greater precision values.
- Decimal point is now acceptable in database names, e.g. "Canon SLR 1.6x"
- Pressing Return key o the main LensFix window executes the plug-in settings on the target image. The "Ok" button is now the default button for this window.
- Included fovCalculator so users can calculate the field of view for their cameras.

Version 2.0.4:

- Added 16 bit support to all the plug-ins
- Added Photoshop "actionability" to Adjust, Correct, Perspective and Remap filters

Version 1.0.2:

- Added LensFix - fully actionable

Version 1.0:

- Initial OS X release