

SynthEyes Lens Distortion Tool User Manual

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The SynthEyes Lens Distortion Tool is designed to either remove lens distortion from as-shot source imagery, or to apply lens distortion to rendered 3-D computer graphics imagery. In either case, the amount of lens distortion is determined using the SynthEyes Camera Tracker: with either the manual line-matching tool, or as calculated during the 3-D solving process. The result is that computer-generated imagery can more exactly integrate with the original source material.

Usually, you will be applying lens distortion to your computer-generated effects, then compositing the distorted effects with the original source images (using your favorite compositing application). Distorting or undistorting the images necessarily softens them somewhat. If you undistort the source, insert effects, then re-distort the result, the images will be softened twice, instead of only once if you only distort the inserted effects. Since you will typically be adding noise or grain to the inserted effects to match the source shots, the slight softening of the inserted CGI is not a particular problem, but may actually be helpful in matching source.

Note that distorting or undistorting a shot may result in some edge portions of the shot being lost, or empty border portions being introduced. These empty portions can be filled with black or a specified color.

If you are just starting with the SynthEyes Lens Distortion Tool, see the installation section at the end of this document.

Scope of Operations

The SynthEyes Lens Distortion Tool is a standalone program, independent of SynthEyes, designed solely for lens distortion application and removal. As such, it does **not** include, by design, any compositing features: better to use a compositing program designed for this function, which can offer much more flexibility and capability. The Lens Distortion Tool is a complement, not a replacement.

Nor is the Lens Distortion Tool intended to act as a general format conversion tool. It will permit some file conversions, but it is not intended primarily for this function. Cineon files can only be output if Cineon files are input.

Finally, as a professional-level tool intended for off-line effects, some image formats are not supported by design: only sequenced image input/output are supported, not “movie” formats such as AVI, QT, MPEG, or DV. Furthermore, lossy formats, notably JPEG, are not supported, as recompression will degrade image quality beyond usability. If your workflow demands that you use an unsupported format, you can run the source material through your favorite format conversion software, such as any compositor or 3ds max’s Video Post tool.

Operating Summary

The SynthEyes Lens Distortion Tool is straight-forward to operate. You should use SynthEyes to determine the amount of distortion in your source imagery, using the manual alignment lines, or as part of a 3-D camera match. Starting the SynthEyes Lens

Distortion Tool, copy and paste the lens distortion value from the Lens control panel in SynthEyes into the distortion control of the Lens Distortion Tool.

Next, select the first frame of the input image sequence using the **Read: Start** filename's **Browse** button. This will select the entire shot, up through the last file. If you want only part of the shot, set the **Read: End** filename to the last input file to be processed, using the corresponding **Browse** button.

Set up the name of the first output image using the **Write** filename's **Browse** button.

Set the physical film or image sensor aspect ratio (width divided by height) of the source images, using either the presets for typical values such as 4:3 or 16:9, or enter the numeric value. If the imagery is interlaced video, turn on the interlaced checkbox (no odd/even setting is required).

Select either the Apply or Remove Distortion buttons, depending on which you'd like to do.

Hit Go to begin distorting the image sequence. The frame counter field at the bottom will activate, showing the number of frames already processed, and the total to be processed, along with a progress bar of the overall progress.

The SynthEyes Lens Distortion Tool will proceed on multiple frames simultaneously, if the computer supports that. A quad-processor machine will have two threads, a hyper-threaded single-processor Intel machine will have two threads, a machine with four hyper-threaded processors will have eight threads. Note that the threads interfere with one another somewhat, so that two threads aren't necessarily twice as fast as one thread: they are both contending for a single disk drive, for example.

Hyper-threading is present on Prescott-class Intel Pentium 4 processors with an E suffix, for example, a P4 3.0E processor. As processor designs are introduced all the time, it may be present on other machines as well. Hyper-threading can be enabled or disabled from your BIOS, so even if the processor is capable, it may be disabled. Check with your computer's manual for more details.

If you wish to proceed with other tasks on your computer while the lens distortion is processed, you can specify a reduced number of threads using the corresponding control on the Lens Distortion Tool control panel, so that some processor resources remain to handle your other tasks effectively.

If you decide you need to stop processing, hit the Cancel button. Note that frames currently being processed will continue being processed; the cancellation will prevent new frames from being launched, so there may be a short delay.

More About Lens Distortion

Lens distortion originates within the camera's lens, of course, centered around a point called the optical axis that shoots straight down the center of all the lenses that make up the overall camera lens. The optic axis continues through the camera until it intersects with the imaging plane, where the film or silicon video-camera chip is located. Ideally, the SynthEyes Lens Distortion Tool calculates, then applies or removes, distortion emanating from the optic center point of your imagery.

Nominally, the optic center point falls exactly at the center of the imagery, but it does not always do so, for the same sort of reasons that the lens contains distortion in the first place. In theory, it is possible to calculate the optic center location as part of the

camera-matching process, but also in theory, it is quite hard to do so with any degree of exactness, because the exact center point makes little difference in the distortion induced. Since distortion emanates radially from the optic center, if you think of a 3-pixel distortion (displacement) somewhere out at the edge of the image, the final location does not depend much on a 10-pixel shift in center position, where the center is located 300 pixels away —only 0.1 pixel change in displacement may result.

The center point can be determined by shooting calibration imagery of special fixtures created with computer-controlled machine tools or wide-bed plotters, but this is rare and generally overkill. Calculating the optic center point as part of a normal camera matching process turns out to destabilize the overall calculations (a consequence of the optic center being hard to calculate accurately).

For all of these reasons, most animation packages do not have a camera object that allows an optical center point to be specified. They place the optic center at the center of the image. Even if we were to calculate the optic center point, we'd have little to do with that information.

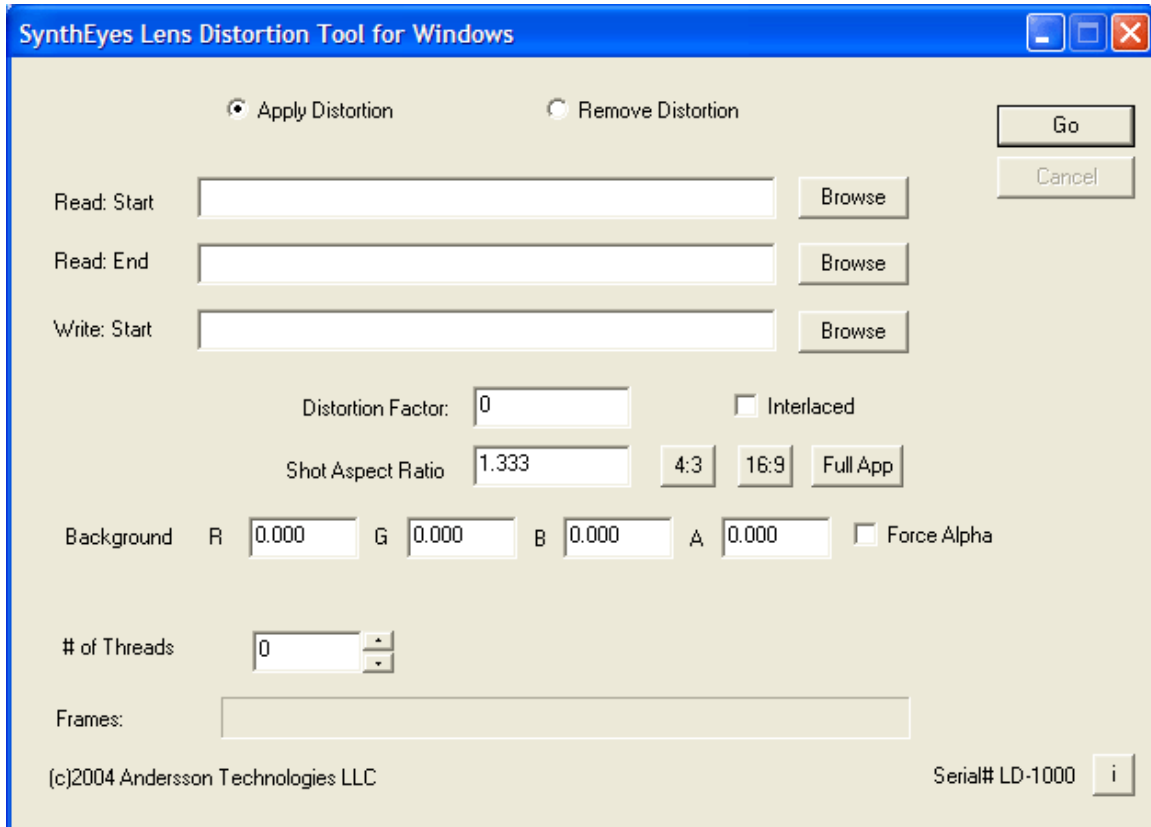
So similarly, the SynthEyes Lens Distortion Tool makes the assumption that the optic center point falls exactly in the center of the image, and this is generally quite good enough, because, as described, the lens distortion does not actually depend very much on the exact center location. By calculating the camera match with this assumption, SynthEyes calculates the match that will best match what the animation package will do.

There is one important circumstance where assuming that the optic center falls in the center of the image is unsatisfactory: if the source is shot on full-aperture film, and subsequently cropped (vertically) to a wider aspect ratio, such that the cropping is not centered at the optic center. For example, the cropping may also be re-framing to center on some object of interest.

First, you should actively discourage this from occurring, instead, encourage this cropping to happen after the effects insertion.

Second, if it does happen in a seriously off-center fashion, you can pad the frames back up to their original size using your compositing application, by inserting them at approximately the correct location into a black frame with the same size and aspect as the original. If you use an image format that supports (lossless) compression, such as Targa, PNG, or SGI RGB, then the image size on disk will be minimally affected. Feed these frames into SynthEyes, generate your effects imagery at this full-frame image size, composite, then re-crop to the final output size.

Control Panel Reference



Go. Starts the lens distortion correction process, using the currently-configured settings.

Hit this after adjusting everything else.

Cancel. Stops the lens distortion process if it is running, grayed out if it is not.

Apply Distortion. Causes distortion to be applied to the source imagery, usually pristine CGI being distorted to match the original shot.

Remove Distortion. Causes distortion to be removed from the shot, typically original source photography that is being rectified to eliminate distortion.

Read: Start (+Browse). The file name of the first frame of source images to be processed. Use the associated browse button to simplify identifying this.

Read: End (+Browse). The file name of the last frame of source imagery to be processed. *You can leave this blank* and then the Lens Distortion Tool will process frames sequentially until there are no more in the sequence. So use the End setting if only a portion of the sequence must be processed.

Write (+Browse). The file name of the first frame of the sequence to be written. Do not let this be the same as the Read: Start setting. Either use a different file name, or write the output to a different folder. Overwriting the input sequence is unwise.

Distortion Factor. The amount of distortion, positive or negative, present in the lens, as obtained from (preferably by *Copy* and *Paste*) the SynthEyes lens control panel. Note: use Apply or Remove Distortion to control what you want to do, this is not the same as changing a positive distortion to negative or vice versa.

Interlaced. Check if the source material is interlaced video. No odd or even setting is required.

Shot Aspect Ratio (plus preset buttons 4:3, 16:9, Full App). The aspect ratio of the original shot, such as 1.3333 for 4:3, etc. Use the presets if applicable, otherwise, please enter an accurate number for best results.

Background: R,G,B,A. Depending on the distortion being added or removed, portions around the edge of the output image may not be available from the source images. In this case, the Lens Distortion Tool will fill the pixels from these R/G/B/A settings. Each value can range from zero to 255.996 or so. The default transparent black setting will be most useful.

Force Alpha. When enabled, an alpha channel will be present in the output images (if the format permits), even if none is present in the input. This alpha channel will consist of full-intensity white for pixels from the input image, and dead black for pixels that were off the edge of the source (note that the RGBA settings can change this alpha value).

of Threads. The number of frames that will be simultaneously processed by your computer. The default value of zero will cause the largest value for your machine to be used.

Frames (text plus progress bar). Shows the progress through the sequence, ie 34/96 means that it has completed 34 of 96 frames. This is reflected in the progress bar as well.

Command Line Reference

The SynthEyes Lens Distortion Tool features a command-line interface that can be used to control it from scripts. When a file name that contains spaces is placed on the command line, it should be enclosed in double-quote characters (“file name”). There should be a space between the argument and any following value, for example, between `-asp` and the aspect ratio value. The arguments recognized are listed below:

<code>-s filename</code>	Sets the starting file name
<code>-e filename</code>	Sets the ending file name
<code>-o filename</code>	Sets the output file name
<code>-a</code>	Apply lens distortion
<code>-r</code>	Remove lens distortion
<code>-asp value</code>	Set the aspect ratio
<code>-d value</code>	Set the distortion coefficient
<code>-i</code>	Shot is interlaced
<code>-nt value</code>	Set the number of threads
<code>+alpha</code>	Add an alpha channel. Note the plus sign for adding alpha.
<code>-c R G B A</code>	Set the background color. Each channel ranges 0 to 255.996.
<code>-go</code>	Start processing automatically, and exit when done.

System Requirements

- Pentium 3 or later, or AMD Athlon
- Windows XP or 2000
- 128 MB RAM
- Multiple processors and hyper-threading supported, but not required.

Specifications

- Input/output image formats: Targa, Cineon, TIFF, PNG, SGI, BMP
- Apply or remove distortion with SynthEyes-compatible coefficient
- RGB or RGB plus alpha images when available.
- 8 bits/channel nominal, 16 bits/channel for some formats.
- Internally 16 bits/channel, four channels (RGBA).
- Multiple-processor and hyper-threaded acceleration

Installation

The SynthEyes Lens Distortion Tool is installed (or uninstalled) with a standard Windows installer.

The first time you launch it after installation, you will be requested to supply the serial number. Copy it onto the Windows clipboard by highlighting it within the e-mail message that was sent to you with it, then hit control-C. Then click the OK button on the SynthEyes Lens Distortion Tool's serial number dialog box to enter it in. This process is designed to eliminate typical typing miscues.