



©2008 The Foundry Visionmongers Ltd. All rights reserved.

Furnace User Guide

This manual, as well as the software described in it, is furnished under license and may only be used or copied in accordance with the terms of such license. This manual is provided for informational use only and is subject to change without notice. The Foundry assumes no responsibility or liability for any errors or inaccuracies that may appear in this book.

No part of this manual may be reproduced, stored in a retrieval system, or transmitted in any form without the prior written permission of The Foundry.

The Foundry logo is a trademark of The Foundry Visionmongers Ltd. Furnace is a registered trademark of The Foundry Visionmongers Ltd. All other products or brands are trademarks or registered trademarks of their respective companies or organisations.

Images illustrating video interlacing courtesy of Ron Brinkmann (<http://www.digitalcompositing.com>).

Software engineering: Ben Kent, Andy Whitmore.

Product testing: Jack Binks.

Writing and layout design: Eija Narvanen using Adobe FrameMaker.

Proof reading: Eija Narvanen.

Contents

Introduction

About this User Guide.....	1
What's New?.....	1
Example Images	1
Notation	2
Installing Furnace	2
Licensing Furnace	3
About Furnace Plug-ins	3
Other Foundry Products	4

DeFlicker

Introduction	1
Quick Start	2
Parameters	2
Example.....	3

DeNoise

Introduction	5
Quick Start	5
Parameters	6
Example.....	7

DirtRemoval

Introduction	11
Quick Start	13
Parameters	13
Examples.....	14

Kronos

Introduction	17
Quick Start	17
Parameters	23

	Examples	26
MatchGrade	Introduction	29
	Quick Start	30
	Parameters	30
	Example.	32
MotionBlur	Introduction	35
	Quick Start	35
	Parameters	38
	Example.	40
ReGrain	Introduction	43
	Quick Start	44
	Parameters	48
	Example.	50
Appendix A	Release Notes.	51
Appendix B	End User License Agreement	53
Index	A-Z	63

INTRODUCTION

Welcome to this User Guide for Furnace on Final Cut Pro.

Furnace is a rich collection of image processing tools to help compositors tackle common problems when working on films. We have spent many years working closely with post production houses in London developing tools that will save you time.

About this User Guide

This User Guide will tell you how to install, license and use the Furnace plug-ins. Each plug-in is described in detail in later chapters.

This guide assumes you are familiar with Final Cut Pro and the machine it is running on.

What's New?

Have a look at the new features and improvements in Appendix A.

Example Images

Example images are provided for use with most of the plug-ins. You can download these images from our web site <http://www.thefoundry.co.uk> and try Furnace out on them. (From the Furnace product page, click on the Tutorials & Example Images link.)

Notation

In this User Guide we will refer to machines running Furnace and Final Cut Pro as *clients* and machines that are running the Foundry FLEXIm Tools software as *servers*.

Before Installing Furnace

Please note that installing Furnace 4.0 will effectively overwrite any previous versions of Furnace 4.0 that have been installed to the default Final Cut Pro location. Scripts will, however, be compatible between Furnace 4.0 versions, and all other Furnace builds with different major and minor version numbers will remain intact.

Installing Furnace

Furnace is available as a download from our web site <http://www.thefoundry.co.uk>. The downloads are in dmg format. Furnace should be installed on the *client* machines.

To install Furnace on a Mac OS X machine running Final Cut Pro, follow these instructions:

1. Download the file from our web site (www.thefoundry.co.uk).
2. Double click on the downloaded dmg file.
Furnace_4.0v2_FCP-mac-universal-release-32.dmg
3. Double click on the pkg file that is created.
Furnace_4.0v2_FCP-mac-universal-release-32.pkg
4. Follow the on-screen instructions to install Furnace directly into the /Library/Plug-ins/FxPlug directory.
5. Proceed to “Licensing Furnace” on page 3.

Directory Structure

The following directories are copied during the default installation process to the following path. Removing these directories will uninstall Furnace.

/Library/Plug-ins/FxPlug/Furnace_4.0_FxPlug1.2.1

/Applications/TheFoundry/Furnace_4.0_FxPlug1.2.1

Licensing Furnace

Without a license key, the Furnace plug-ins will fail to run.

The license key is a sequence of numbers and letters, stored in a plain text file, that unlocks Furnace. License keys can be created for a particular computer enabling those plug-ins to run only on that computer. These are called node locked licenses. We also supply floating licenses that will unlock Furnace on any networked computer connected to a machine running the Foundry license server.

Tools to install license keys, manage floating licenses and diagnose license problems can be downloaded from our web site, <http://www.thefoundry.co.uk/licensing>.

About Furnace Plug-ins

All Furnace plug-ins integrate seamlessly into Final Cut Pro. They are applied to your clips as you would any other plug-in and they can all be animated using the standard animation tools.

You can load Furnace plug-ins from **Effects > Video Filters > Furnace**. Their parameters appear on the **Filters** tab of the Viewer.

All Furnace parameters include two important buttons:

- the **Help** button. When clicked, this displays instructions related to the plug-in.

- The user message button. By default, this is grayed out. The button only activates when Furnace has a message for the user. When this happens, you should click the button to see the message.



Other Foundry Products

The Foundry is a leading developer of plug-in visual effects for film and video post production. Its products include Nuke, Furnace, Tinder, Tinderbox, and Keylight and run on a variety of compositing platforms including Flame, Flint, Fire, Inferno and Smoke from Discreet, Shake, Avid DS and After Effects. For the full list of products and supported platforms see our web site <http://www.thefoundry.co.uk>.

Nuke is an Academy Award® winning compositor. It has been used to create extraordinary images on scores of feature films including *The Dark Knight*, *The Golden Compass*, *Iron Man*, *Transformers*, *King Kong*, and *Pirates of the Caribbean: At World's End*.

Tinder and Tinderbox are collections of image processing effects including blurs, distortion effects, background generators, colour tools, wipes, matte tools, paint effects, lens flares and much more.

Keylight is an award winning blue/green screen keyer giving results that look photographed not composited. The Keylight algorithm was developed by the Computer Film Company who were honoured with a technical achievement award for digital compositing from the Academy of Motion Picture Arts and Sciences.

Visit The Foundry's web site at <http://www.thefoundry.co.uk> for further details.

DeFlicker

When working in film you sometimes have to deal with shots that have a luminance flicker.

Introduction

F_DeFlicker is used to remove flicker that is localised and dependent on the geometry of the scene, such as that caused by an unsynchronised fluorescent light in a shot. It works by calculating the gain between the current frame and each frame in a small window surrounding it. It then tries to adjust the gain so that it varies smoothly over this temporal window. This means it is better at reducing fast flicker than flicker which varies slowly over the image sequence, as the latter will already appear smooth over the window and F_DeFlicker will leave it largely untouched.

The algorithm used by F_DeFlicker can introduce blurring in areas where there is rapid motion. If this happens, using local motion estimation to align the frames before deflickering them can help. However, this process is complicated by the fact that the presence of flicker can adversely affect the results of the motion estimation. F_DeFlicker therefore adopts a two stage approach to this problem. First, the normal deflickering process is performed. The motion vectors for the sequence are calculated on the resulting deflickered frames, then applied to the original frames in order to align them. The deflicker calculation is then performed on the aligned frames to give the final result. To use this approach, turn on **Use Motion** in F_DeFlicker.

Note that F_DeFlicker can be a computationally expensive plug-in that requires input frames from outside the current

time, as such, using more than two instances of F_DeFlicker in an effect stack will dramatically increase render times. It is strongly advised therefore, that you render each instance out separately.

Quick Start

Import a sequence to deflicker. Choose **Effects > Video Filters > Furnace > F_DeFlicker**. Render.

Parameters

The parameters for this plug-in are described below.

Scale Down - use this to scale down the image for deflickering. This can speed up the calculation.

Clamp Flicker - use this to reduce flicker without removing it entirely; smaller values mean more will be left behind.

Use Motion - turn this on to do a second deflicker pass using motion-compensated frames. This can improve results in areas where there is fast motion, where the initial deflicker pass can introduce blurring.

Vector Detail - determines the accuracy of the motion vectors used when **Use Motion** is turned on. The maximum value of 1 will generate one vector per pixel. This will produce the most accurate vectors but will take longer to render.

Window Size - the size of the temporal window to use to remove flicker.

Example

In this example, we'll look at removing flicker from a clip using F_DeFlicker. The clip used here can be downloaded from our web site. For more information, please see "Example Images" on page 1.

Step by Step

1. Import ToDeflicker.mov into Final Cut Pro.
2. Render the sequence loaded in the previous step. Notice the flickering fluorescent light in the window, which we're going to try to remove.
3. Select **Effects > Video Filters > Furnace > F_DeFlicker**.
4. Render the output.
5. Compare the original and deflickered sequences by viewing them one after the other. Notice that the flickering from the light in the window has been substantially reduced.

DeNOISE

This chapter looks at removing noise or grain from an image sequence using Furnace's plug-in F_DeNoise. For hints, tips, tricks, and feedback please visit <http://support.thefoundry.co.uk>.

Introduction

F_DeNoise is designed to remove noise or grain from a clip. Assuming there is no motion in a sequence, the best way to reduce the noise is to take an average across a number of frames (temporal averaging). The noise which is different on each frame will be reduced and the picture which is the same will be reinforced. Temporal averaging is far superior to averaging pixels from within the same frame (spatial averaging) as it doesn't soften the image. Unfortunately, if there is motion in the sequence, the averaged image will be blurred as the image appears at different locations in each frame. However, by estimating the motion in the sequence using The Foundry's advanced motion estimation technology, it is possible to compensate for any motion and so average frames temporally without introducing any blurring artefacts.

Quick Start

Import and select the footage to be noise reduced. In the Canvas, set the zoom level to 100% or higher. Choose **Effects > Video Filters > Furnace > F_DeNoise**. By default, the analysis method of F_DeNoise is set to **Auto-analysis**. This means F_DeNoise automatically tries to pick a suitable sample region defining an area of noise and uses that region when calculating the noise reduction.

If you're not happy with the results of **Auto-analysis**, you can set **Analysis Method** to **Sample Region**. This way, F_DeNoise works by analysing the grain structure in the region around the on-screen sample crosshair. Click on the crosshair button under **Analysis Centre** and move the crosshair over a plain area of the image in the Canvas. To get a good result, it is important that this area is free from image detail, so no textures or edges. The output should now show the denoised frame.

If you are still not satisfied with the results, try moving the sample crosshair to a different, flat area of a frame. F_DeNoise will reanalyse the grain structure every time this crosshair is repositioned.

To remove more noise simply increase the **Tune** parameter. You can also remove different amounts of noise from the red, green and blue channels by altering the **Tune Red**, **Tune Green** and **Tune Blue** parameters.

Parameters

The parameters for this plug-in are described below.

Tune - This adjusts the overall amount of noise or grain that is removed. Increase this value to remove more noise.

The **Fine Tuning** parameters allow you to remove different amounts of noise in each of the colour channels.

- **Tune Red** - increases or decreases the amount of noise removed in the red channel.
- **Tune Green** - increases or decreases the amount of noise removed in the green channel.

- **Tune Blue** - increases or decreases the amount of noise removed in the blue channel.

Analysis Method - Choose how you want to find the flat sample area that is used to analyse the grain structure in the image.

- **Auto-analysis** - let F_DeNoise automatically pick a sample area from the image.
- **Sample Region** - manually pick a sample area from the image.

Auto-analyse button - If **Analysis Method** is set to **Auto-analysis** but you are not happy with the results of the analysis, you can change the frame to analyse on the timeline and then click this button to perform a new automatic analysis.

Analysis Centre - change the position of the centre of the analysis region. Click the button to move the crosshair into a new position on the Canvas, or enter new coordinates for the centre point in the coordinates fields.

Sample Region - shows what is included in the analysis region when you are picking the sample region manually. This area should be free of image detail.

Analysis Frame - shows the frame to analyse on. You cannot adjust this parameter.

Example

The footage used in the following example can be downloaded from our web site. For more information, please see "Example Images" on page 1.

Mike

In this example, we'll use F_DeNoise to remove noise from a sequence.

Step by Step

1. Import MikeWire.mov.



Figure 1. Original image.

2. In the Canvas, set the Zoom pop-up menu to 100% or higher.
3. Select **Effects > Video Filters > Furnace > F_DeNoise**.
4. Render out the sequence to see the results.

5. Compare the original and denoised sequences by viewing them one after the other. Notice that the noise has been reduced.



Figure 2. Zoomed original image.



Figure 3. Zoomed output image.

DIRTREMOVAL

This chapter looks at the removal of dust and dirt from images using Furnace's plug-in F_DirtRemoval. For hints, tips, tricks, and feedback please visit <http://support.thefoundry.co.uk>.

Introduction

F_DirtRemoval will automatically detect and remove specs of dust and dirt from a frame.

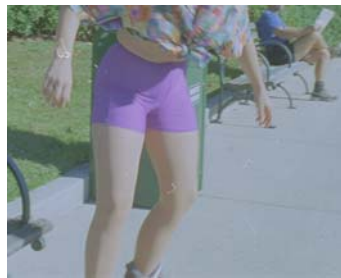


Figure 4. Before.



Figure 5. After.

The plug-in works by looking for objects that appear for only one frame, after taking account of the motion in the sequence. For example:

- A spec of dirt that appears for only one frame will be classified as dirt.
- A football being kicked across the image will not be classified as dirt because, after taking account of motion, it appears in each frame of the sequence.
- A vertical scratch in a sequence will not be classified as dirt as it appears in the same place in each frame.

- Dirt on the camera lens or in the telecine gate will not be classified as dirt as it appears in the same place on each frame.

Having detected the location of the dirt, the algorithm produces a seamless repair by taking motion compensated pixels from the surrounding frames and interpolating them into the dirt region. In order to see which regions have been repaired, you can select **Dirt** under **Output** and render the result, which shows the pixels detected as dirt.

The main control provided by the plug-in is the set of **Presets**. These control the trade off between falsely identifying dirt and failing to spot the dirt. Often, even if a region of image has been falsely detected as dirt, it will be repaired perfectly as the dirt will not have corrupted the motion in the region, allowing a high quality motion compensated repair.

In order to understand how to tune the parameters it is first necessary to understand a bit more about the algorithms involved. F_DirtRemoval relies heavily on motion estimation to both detect the dirt and repair the image. Where the motion is complex, e.g. multiple objects moving fast in multiple directions, we are unable to correctly calculate the motion. This means both the dirt detection and repair will fail. In order to improve results in these regions we have a complex motion detector. This detector is designed to flag regions where we are unlikely to calculate the correct motion. In these regions, we detune the motion based dirt detector and add a spatial dirt detector. Only if both detectors flag dirt do we actually believe there to be dirt.

Quick Start

Import the sequence to be cleaned and select **Effects > Video Filters > Furnace > F_DirtRemoval**. Render and view the result. To see where the dirt has been detected and removed, set **Output** to **Dirt** and render again.

If you think the results could be better, vary the preset applied as required. If regions of motion have been incorrectly classified as dirt, choose a lower preset. If dirt has been missed, try choosing a higher preset.

Parameters

The parameters for this plug-in are described below.

Presets - this is the main control for the plug-in which trades off the amount of dirt detected and repaired verses the number of false detections and incorrect repairs. For archive footage, you should typically choose **Very Aggressive**, whereas for a modern scan with isolated patches of dust you should choose **Cautious** or **Neutral**.

Output - as well as the repaired image it is possible to output diagnostic images which are useful for tuning the parameters.

- **Source** - the original frame containing dirt.
- **Dirt** - a black and white image showing where dirt has been detected.
- **Repair** - the repaired output image.
- **Repair Dirt In Alpha** - the repaired output image with the final dirt shown in the alpha channel. Any alpha in the source image will be removed.

Examples

The images for the following example can be downloaded from our web site.

Roller blades

This clip of a roller blader suffers from a lot of dust.



Figure 6. Roller blader.

Step-by-Step

1. Import Rollerblade.mov. Play it and look at the dirt.
2. Select **Effects > Video Filters > Furnace > F_DirtRemoval**.
3. Make sure **Output** is set to **Repair** and render. Notice how the dust has been reduced in the result.



Figure 7. Repaired image.

4. To see where dirt was detected and removed, set **Output** to **Dirt** and render again.

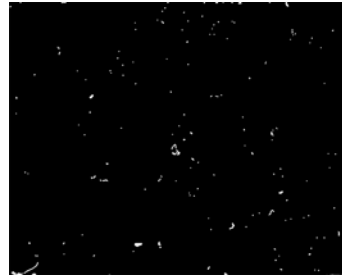


Figure 8. The detected dirt.

KRONOS

Introduction

Kronos is Furnace's re-timer and is designed to slow down or speed up footage. It works by calculating the motion in the sequence in order to generate motion vectors. These motion vectors describe how each pixel moves from frame to frame. With accurate motion vectors it is possible to generate an output image at any point in time throughout the sequence by interpolating along the direction of the motion.

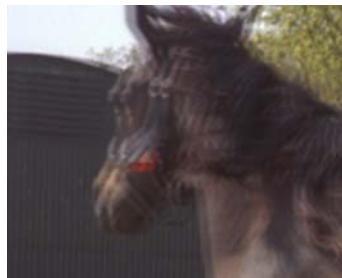


Figure 9. Simple mix of two frames to achieve an inbetween frame.



Figure 10. Kronos vector interpolation of the same two frames.

Kronos contains a number of controls to allow you to trade off render time verses accuracy of vectors. The time controls can be used to generate arbitrary shaped speed curves.

Quick Start

Import the sequence you wish to retime and select **Effects > Video Filters > Furnace > F_Kronos**. By default, the speed control will be set to perform a half speed slow down. This is achieved by generating a new frame at position 0.25 and 0.75 between the original frames at 0 and 1. Frames are

created at a quarter and three quarters instead of zero (an original frame) and a half so as not to include any original frames in the re-timed sequence. This avoids the pulsing that would otherwise be seen every other frame on a half speed slowdown.

Time Curves

To vary the speed, choose **Source Frame** as the **Timing** method and animate the **Frame** parameter. Make sure **Frame** is keyframed. Then, select an output frame from the Timeline and set **Frame** to the input frame you want to appear at that output position. Repeat this for at least one more output position to get a linear time curve. For example, if we wish to do a 4 times slow down, move to frame 1 and set **Frame** to 1, then move to frame 19 and set **Frame** to 5. You can use all the normal time curve tools provided by Final Cut Pro to create any time curve you might need. If the motion is speeded up, motion blur will be seen.

Alternatively, you can switch the **Timing** pulldown menu to **Speed** and use the **Speed** control to create an arbitrarily changing speed for the sequence.

Tuning Parameters

At this point, you can render a re-timed sequence using the default parameter settings. Better results may be achieved by tuning Kronos using the following parameters.

Adjust **Vector Detail** to get a higher resolution vector field. The larger **Vector Detail** is, the greater the processing time but the more accurate the vectors should be. A value of 1 will generate a vector at each pixel. A value of 0.5 will generate a vector at every other pixel.

Note *In some circumstances, you may find that a lower Vector Detail may give smoother more natural looking results, even though they are less accurate.*

Use **Smoothness** to adjust the smoothness of the vectors generated. A high smoothness will miss lots of local detail, but is less likely to provide you with the odd spurious vector. A low smoothness will concentrate on detail matching, even if the resulting field is jagged.

Using Placeholder Frames in Slow Downs

When slowing down footage, you may notice that you cannot access the entire clip after applying F_Kronos to it. For example, if your clip is 50 frames long and you slow it down to half a speed, 25 frames of the original clip are left outside the accessible frame range. To be able to access the entire original clip, you can make the clip longer by adding black placeholder frames to it and embedding them and the original clip in a sequence before using F_Kronos. Do the following:

1. In the Browser, go to the **Effects** tab.
2. Double-click on **Video Generators**.
3. Select **Slug** and drag it to the timeline either before or after your footage, depending on where you need the black placeholder frames.
4. On the timeline, resize the slug as necessary by dragging its edges to a new position. The slug and the clip together should cover the frame range you want to use for the retimed sequence.
5. In the Browser, go to the project tab.
6. Right-click on an empty spot and select **New Sequence**.
7. Right-click on the newly created sequence and select **Open Timeline**. A new tab appears on the timeline.

8. Drag the earlier sequence that contains the original footage and slug on the new timeline tab.
9. Right-click on this sequence on the timeline and select **Open in Viewer**.
10. Apply F_Kronos.

Motion Blur without Retiming

You can add motion blur without retiming. To do this, set the **Speed** to 1. Then set **Shutter Time** (the output shutter time) to be a value greater than 1 (Figure 14 on page 25). Increase **Shutter Samples** until you don't see multiple images (say 10). This will add motion blur along the direction of motion without retiming (Figure 17 on page 26). Alternatively, you can use the simpler F_MotionBlur plug-in, described on page 35.

Frames and Fields

For various historical reasons, video frames are usually divided into two *fields*. Each field contains only half of the image information, drawn as horizontal scan lines. The first field of a frame contains every other scan line. These scan lines are displayed first from top to bottom. Immediately after, the remaining scan lines are displayed, similarly from top to bottom. They make up the second field of the frame. When both fields are displayed in rapid sequence, they appear to produce a normal, complete frame. This technique of dividing frames into fields and then displaying them

immediately after each other is called *interlacing*. It is illustrated in Figure 11.

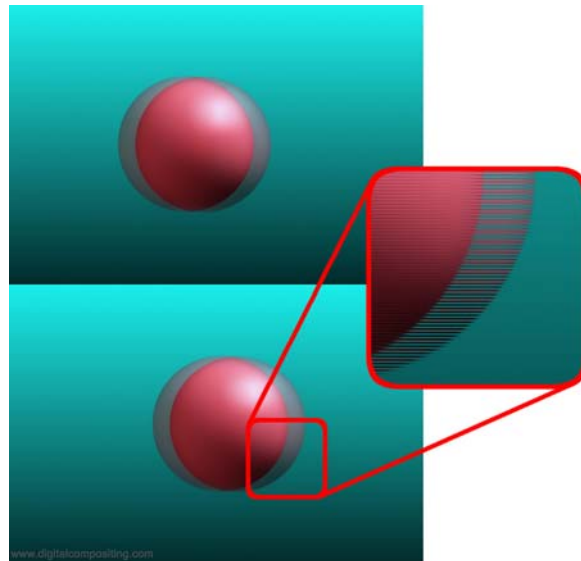


Figure 11. Video frames consist of two interlaced fields.

When a moving object is captured using an interlaced video format, the object appears in a slightly different place in each field of the same frame. This is because the second field is recorded after the first field. For example, let's imagine a clip that shows a ball moving from left to right across the screen. Figure 12 shows what two frames from this clip might look like and how these frames could be represented as two fields. As you can see, the ball moves slightly to the right between fields, and the fields appear squashed, because they only contain half of the image information. You should also notice that because the fields are recorded and displayed immediately after each other and two fields make up one frame, the ball does not move quite

as far between two fields as it does between two frames.

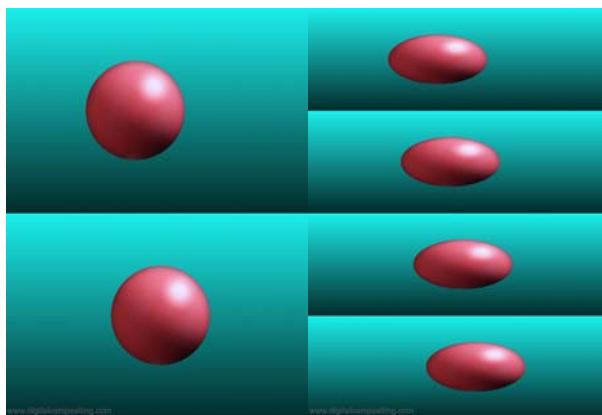


Figure 12. Two frames (on the left) divided into fields (on the right).

Kronos is able to retime between frames and between fields. This is illustrated in Figure 13.

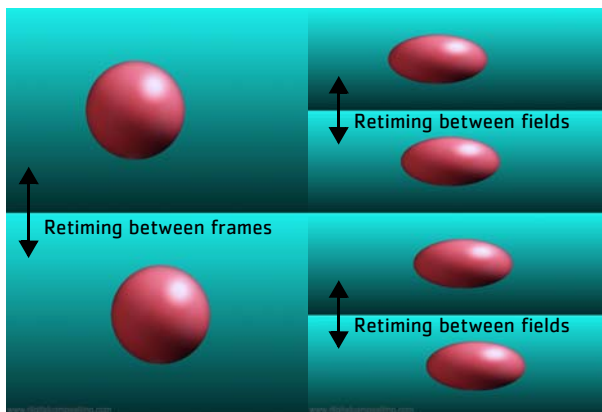


Figure 13. Retiming between frames and between fields.

By default, the retime operation is applied to frames. Because any moving objects will be further apart between frames than between fields, this can produce a slightly riskier retime. To get better results for the retime, you can perform the retime on fields instead of frames. This way, the moving objects will be closer to each other, which improves the results of the motion estimation. However, because the retime is done between fields, and the scan lines that produce the image are slightly apart vertically, the results are vertically shifted by one pixel. This can introduce vertical jitter in the retimed clip.

You can choose whether to retime between frames or fields using the Retime Fields parameter.

Parameters

The parameters for this plug-in are described below.

Method - sets the interpolation algorithm.

- **Frame** - the nearest original frame is displayed.
- **Blend** - a mix between two frames is used for the in-between frame. This is quick to render and useful when tweaking the timing on the curve before setting the method to motion.
- **Motion** - vector interpolation is used to calculate the in-between frame.

Timing - sets how to control the new timing of the clip.

- **Speed** - select this if you wish to describe the retiming in terms of overall duration, i.e., double speed will halve the duration of the clip or half speed will double the duration of the clip.

- **Source Frame** - select this if you wish to describe the retiming in terms of "at frame 100 in the output clip I want to see frame 50 of the source clip". You'll need to set at least 2 keyframes for this to retime the clip.

Speed - this parameter is only active if **Timing** is set to **Speed**. Values below 1 slow down the clip. Values above 1 speed up movement. For example, to slow down the clip by a factor of two (half speed) set this value to 0.5. Quarter speed would be 0.25.

Frame - this parameter is active only if **Timing** is set to **Source Frame**. Use this to specify the source frame at the current frame in the timeline. For example, to slow down a 50 frame clip by half set the **Frame** to 1 at frame 1 and the **Frame** to 25 at frame 50. The default expression will result in a half-speed retime.

Vector Detail - Adjust this to vary the resolution of the vector field. The larger vector detail is, the greater the processing time, but the more detailed the vectors should be. A value of 1.0 will generate a vector at each pixel. A value of 0.5 will generate a vector at every other pixel. For some sequences, a high vector detail near 1.0 generates too much unwanted local motion detail; often a low value is more appropriate.

Smoothness - Vector fields usually have two important qualities: they should accurately match similar pixels in one image to another and they should be smooth rather than noisy. Often, it is necessary to trade one of these qualities off against the other. A high smoothness will miss lots of local detail, but is less likely to provide you with the odd spurious vector. A low smoothness will concentrate on detail matching, even if the resulting field is jagged. The default

value of 0.5 should work well for most sequences.

Warp Mode – sets how to control the new timing of the clip.

- **Simple** – this is the quickest option, but may produce less than optimal results around moving objects and image edges.
- **Normal** – this is the standard option, with more optimal treatment of moving objects and image edges.
- **Occlusions** – this is an advanced option that can improve the results when not doing a separated picture build with multiple vector layers and mattes. It attempts to reduce the level of background dragging that occurs between foreground and background objects.

Shutter Time – sets the equivalent shutter time of the re-timed sequence. A shutter time of 1 is equivalent to averaging over plus and minus half an input frame which is equivalent to a shutter angle of 360 degrees. A shutter time of 0.5 is equivalent to a shutter angle of 180 degrees. Imagine a grey rectangle moving left to right horizontally across the screen. Figure 14 and Figure 15 show how **Shutter Time** affects the retimed rectangle.



Figure 14. Shutter Time 1



Figure 15. Shutter Time 0.5

Shutter Samples – sets the number of in-between images used to create an output image during the shutter time. Increase this value for smoother motion blur.



Figure 16. Shutter Samples 2



Figure 17. Shutter Samples 20

Auto ShutterTime – automatically varies the Shutter Time throughout the sequence.

Retime Fields – sets whether the retime operation is performed between frames or fields.

- **From Frame to Frame** – retimes between complete frames. This can produce a slightly riskier retime, but the results will be on the correct scan line.
- **From Field to Field** – retimes between the fields that are used to make up frames. This produces a better retime, but the results are shifted vertically by one pixel, which may introduce vertical jitter in the retimed clip.

Examples

All the images for the following example can be downloaded from our web site.

Taxi

This example, Figure 18 on page 27, shows a taxi driving past our offices in Soho. We'll retime this sequence to speed up the taxi at the start and slow down at the end.



Figure 18. London taxi.

Step by Step

1. Start Final Cut Pro and import Taxi.mov.
2. Render the taxi clip to get a sense of the motion.
3. Select **Effects > Video Filters > Furnace > F_Kronos**.
4. By default, the clip will be slowed down to half speed. However, we wish to have a fast start and slow end. So, set **Timing** to **Source Frame**. At frame 1, set a **Frame** key to be 1, and at frame 50 set a **Frame** key to 25. Now to get that fast start, try setting the **Frame** key to be 12 at frame 15. Use the keyframe graph area to modify the animation graph.
5. To get a sense of the motion you can set **Method** to **Blend**, render and adjust your timing curve from there.

6. When you're happy, set **Method** to **Motion**. With **Vector Detail** set to 0.2, you may see part of the road under the taxi being dragged by the taxi. To improve this, increase this value to 1.

MATCHGRADE

This chapter looks at automatic colour matching using Furnace's plug-in F_MatchGrade. For hints, tips, tricks, and feedback please visit <http://support.thefoundry.co.uk>.

Introduction

It is often necessary to match the colours of one clip with those of another. When filming outside at different times of the day you will inevitably get colour and luminance differences that will have to be corrected if the sequences are to be composited or edited together.

You can, of course, use colour correction tools and trial and error to try and match the clips. But this tends to be time consuming and requires some considerable skill. F_MatchGrade does it all for you by automatically modifying the colour histogram of an image to match a target image.

This plug-in can also be used to add colour to black and white images.



Figure 19. Source image



Figure 20. Target image



Figure 21. Output image

Quick Start

Import the clips you want to use as the source and target clips. The source clip is the sequence to which the colour transform will be applied. The target clip is the sequence you want the source clip to match. Select the source clip and choose **Effects > Video Filters > Furnace > F_MatchGrade**. Drag the target clip to the clip well of the **Target** parameter. View the output which should now match the look of the target clip. Try increasing **Iterations** if the match isn't close enough.

By default, F_MatchGrade calculates the transform needed to match the source image frame to the target image frame, and applies this transform to every frame of the source sequence. This way, the transformation is temporally uniform. However, if you want the colour transfer to update according to the current frame of the source and target clips, you can set the **Source Colour From** and **Target Colour From** parameters to **Current Frame**.

Parameters

The parameters for this plug-in are described below.

Target - drag the target clip (the clip whose colours you want the source clip to match) here.

Iterations - the number of refinement passes. More iterations should produce a better match but will take longer. This is an integer parameter, so animating it will not produce a smooth grade change but one with obvious steps. To achieve a smooth grade change, mix the output from **F_MatchGrade** with the original input sequence and animate the mix amount.

Source Colour From - sets how the source clip is used to calculate the colour transformation.

- **Specified Frame** - the colour transformation is calculated using a single frame from the source clip. You can specify this frame using the **Source Frame** parameter below.
- **Current Frame** - the colour transformation is calculated so that it updates according to the frames in the source clip.

Source Frame - sets the source clip frame that is used to calculate the colour transformation.

Target Colour From - sets how the target clip is used to calculate the colour transformation.

- **Specified Frame** - the colour transformation is calculated using a single frame from the target clip. You can specify this frame using the **Target Frame** parameter below.
- **Current Frame** - the colour transformation is calculated so that it updates according to the frames in the target clip.

Target Frame - sets the target clip frame that is used to calculate the colour transformation.

Example

Mike

In this example, we will use F_MatchGrade to match the look of two images, MikeWalking.tif and MikeLightWand.tif. The images used here can be downloaded from our website. For more information, please see “Example Images” on page 1.

Step by Step

1. Import MikeWalking.tif and MikeLightWand.tif – our goal is to make the image with the light stick lighter and more like the other. They are shown in Figure 22 and Figure 23.



Figure 22. Source image



Figure 23. Target image

2. Select the light stick image and choose **Effects > Video Filters > Furnace > F_MatchGrade**.

3. Drag the walking image into the clip well of the **Target** parameter. You should get the result in Figure 24.



Figure 24. Output image

4. The result is slightly garish, so decrease the **Iterations** parameter to 3, the result of which is shown in Figure 25.



Figure 25. Output image

MOTIONBLUR

This chapter looks at adding motion blur using Furnace's plug-in F_MotionBlur. For hints, tips, tricks, and feedback please visit <http://support.thefoundry.co.uk>.

Introduction

F_MotionBlur uses the Foundry's advanced motion estimation technology to add realistic motion blur to a sequence. F_MotionBlur uses the same techniques and technology as the motion blur found in F_Kronos, but presents the controls in a less complex, more user friendly way. However, if you need precise control over the motion vectors used for adding blur, or a large temporal range (i.e. a very high shutter time), you should use F_Kronos.

Quick Start

Import a clip and select **Effects > Video Filters > Furnace > F_MotionBlur**. Select a suitable **Shutter Time**, depending on the amount of blur you wish to add. Process the sequence to see the motion blurred result. Increasing **Shutter Samples** will result in more in-between images being used to generate the motion blur and a smoother blur. If you can see that the motion blur has been created from a few discrete images, try increasing **Shutter Samples**.

If your sequence is composed of a foreground object moving over a background, the motion estimation is likely to get confused at the edge between the two.

Frames and Fields

For various historical reasons, video frames are usually divided into two *fields*. Each field contains only half of the image information, drawn as horizontal scan lines. The first field of a frame contains every other scan line. These scan lines are displayed first from top to bottom. Immediately after, the remaining scan lines are displayed, similarly from top to bottom. They make up the second field of the frame. When both fields are displayed in rapid sequence, they appear to produce a normal, complete frame. This technique of dividing frames into fields and then displaying them immediately after each other is called *interlacing*. It is illustrated in Figure 26.

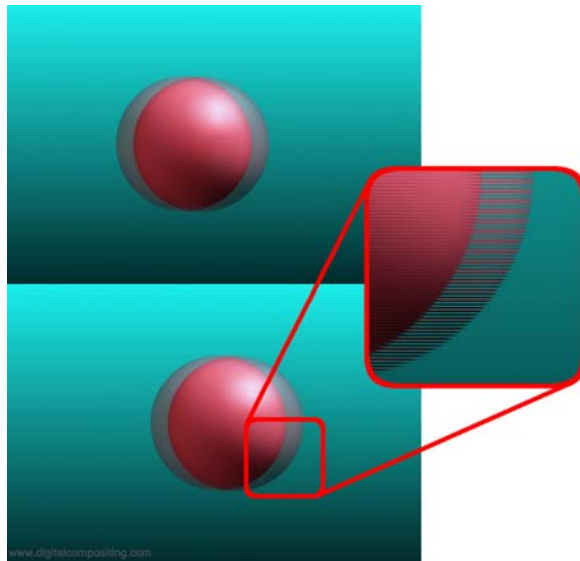


Figure 26. Video frames consist of two interlaced fields.

When a moving object is captured using an interlaced video format, the object appears in a slightly different place in each field of the same frame. This is because the second

field is recorded after the first field. For example, let's imagine a clip that shows a ball moving from left to right across the screen. Figure 27 shows what two frames from this clip might look like and how these frames could be represented as two fields. As you can see, the ball moves slightly to the right between fields, and the fields appear squashed, because they only contain half of the image information. You should also notice that because the fields are recorded and displayed immediately after each other and two fields make up one frame, the ball does not move as far between two fields as it does between two frames.

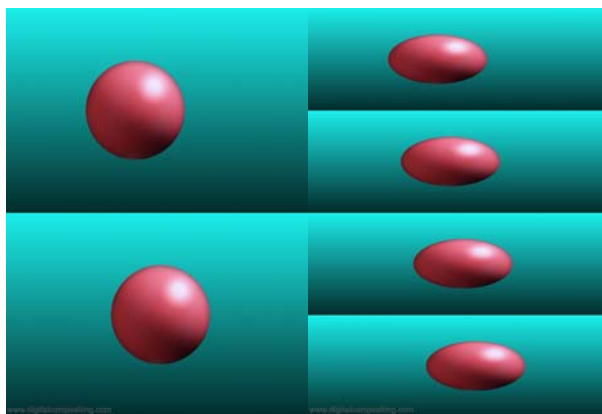


Figure 27. Two frames (on the left) divided into fields (on the right).

MotionBlur is able to retime between frames and between

fields. This is illustrated in Figure 28.

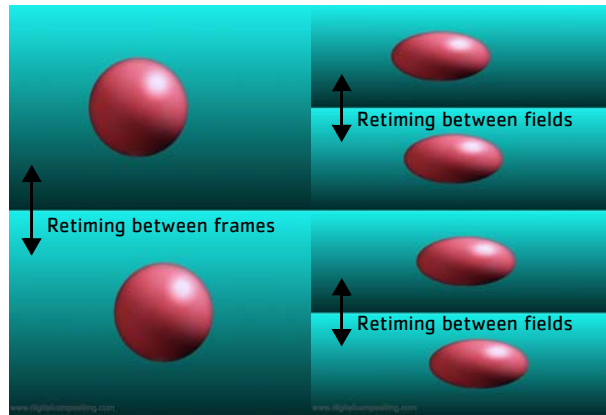


Figure 28. Retiming between frames and between fields.

By default, the retime operation is applied to frames. Because any moving objects will be further apart between frames than between fields, this can produce a slightly riskier retime. To get better results for the retime, you can perform the retime on fields instead of frames. This way, the moving objects will be closer to each other, which improves the results of the motion estimation. However, because the retime is done between fields, and the scan lines that produce the image are slightly apart vertically, the results are vertically shifted by one pixel. This can introduce vertical jitter in the retimed clip.

You can choose whether to retime between frames or fields using the Retime Fields parameter.

Parameters

The parameters for this plug-in are described below.

Shutter Time - sets the equivalent shutter time of the retimed sequence. A shutter time of 1 is equivalent to averaging over plus and minus half an input frame which is equivalent to a shutter angle of 360 degrees. A shutter time of 0.5 is equivalent to a shutter angle of 180 degrees. Imagine a grey rectangle moving left to right horizontally across the screen. Figure 29 and Figure 30 show how Shutter Time affects the retimed rectangle.



Figure 29. shutterTime 1



Figure 30. shutterTime 0.5

Shutter Samples - sets the number of in-between images used to create an output image during the shutter time. Increase this value for smoother motion blur.



Figure 31. shutterSamples 2



Figure 32. shutterSamples 20

Vector Detail - the amount of detail used for the motion

estimation. The maximum value of 1 will produce the most accurate motion vectors, but will take longer to render.

Retime Fields – sets whether the retime operation is performed between frames or fields.

- **From Frame to Frame** – retimes between complete frames. This can produce a slightly riskier retime, but the results will be on the correct scan line.
- **From Field to Field** – retimes between the fields that are used to make up frames. This produces a better retime, but the results are shifted vertically by one pixel, which may introduce vertical jitter in the retimed clip.

Example

All the images for the following example can be downloaded from our web site. For more information, please see “Example Images” on page 1.

BelleWalking

In this example, we’ll use `F_MotionBlur` to add motion blur to the sequence.

Step by Step

1. Start Final Cut Pro and import the BelleWalking.mov clip.
2. Render the clip to get a sense of the motion. Go to frame 16 on the time line (this merely gives a better example than the initial frames).
3. Select **Effects > Video Filters > Furnace > F_MotionBlur**.

4. Set **Shutter Time** to 10, and **Shutter Samples** to 10. You should get an image as in Figure 33.



Figure 33. Output image

5. We can see the individual samples still, for example at the back of the dress and the right-hand foot. Increase **Shutter Samples** to 20 to sample more frames, and you should get a result as in Figure 34.



Figure 34. Output image

REGRAIN

Introduction

Furnace's ReGrain plug-in is used to add grain to a sequence. It has been designed to sample grain from one image and then to generate unlimited amounts of this grain with exactly the same statistics as the original. This new grain can then be applied to another image.

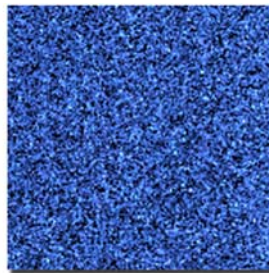


Figure 35. Kodak 320.

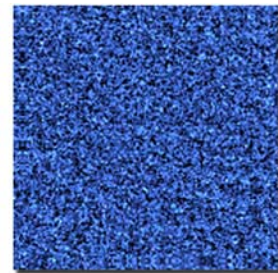


Figure 36. ReGrain.

Figure 35 shows an enlarged and exaggerated sample of grain from Kodak 320 film stock. Furnace's ReGrain was used to sample the original Kodak 320 stock and synthesize a plate of grain. The result is shown in Figure 36. Note that the grain characteristics closely match the original.

Similarly, Figure 37 on page 44 is a sample from Kodak 500 film stock and Figure 38 on page 44 shows this replicated

using Furnace's ReGrain.

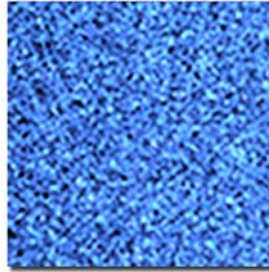


Figure 37. Kodak 500.

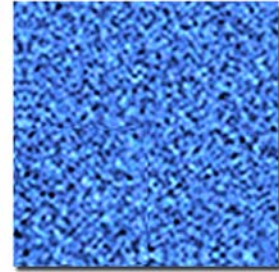


Figure 38. ReGrain.

Quick Start

Import the clip to which you want to add grain and select **Effects > Video Filters > Furnace > F_ReGrain**. There are a variety of presampled grain types to choose from. Try the different grain types using the **Stock Type** pulldown menu.

If you don't want to use one of the presampled grain types, you can also sample grain from a clip. To do so, set **Stock Type** to **Sample Grain**. Import a clip you want to sample and drag it into the clip well of the **Grain** parameter. Check **View Grain Clip** to display this clip in the Canvas. Click on the button under **Analysis Centre** and move the selection area over a plain area of the image in the Canvas. Your selection is important to get right. You should avoid any image detail or even a plain area that has luminance variations underneath the grain. The better this initial selection the better the result will be. See Figure 39. If you can't find a decent sample area on the frame, then try other frames from

the same film stock.

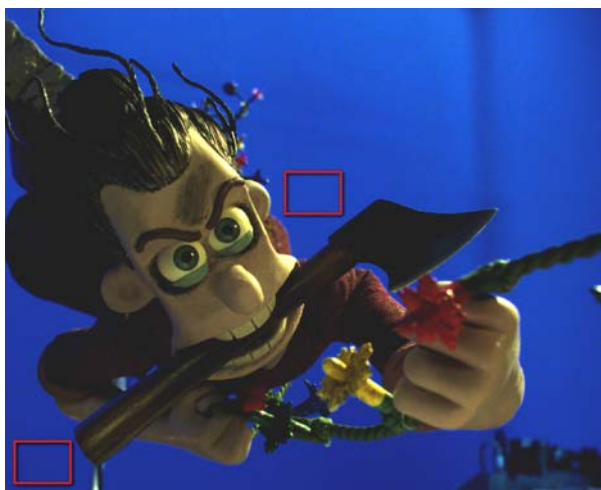


Figure 39. This shows two possible selection regions that contain no edge detail and little luminance variation.

Note *The red selection box on the Canvas is not an overlay but actual pixels on the image displayed. If you render the grain clip, the selection box will be included in the output.*

Once you have positioned the sample area, view the output of the F_ReGrain node to judge the results. The output will now contain the source image with grain from the sample image applied. Both the size and the luminance of the new grain can be manually tweaked using **Grain Scale** and **Grain Gain** respectively.

The grain is sampled on a single frame which you set using the timeline. Although the grain is sampled on only one frame, the algorithmically created grain will change from frame to frame but mirror the characteristics of the sample

grain.

There is a minimum size of the sample clip below which the statistical analysis of the grain will be unreliable. The minimum size is about 128x128.

Grain Stock

To add grain from a standard film stock, select from the **Stock Type** list. 2K, 4K, aperture corrected and non aperture corrected stocks are included. Individual colour channels can be selected and adjusted using the **Gain** and **Scale** parameters.

Response

In its default setting, F_ReGrain adds the same amount of grain over the whole image. However, the amount of grain on an image is normally a function of luminance. You can adjust how the amount of grain added varies with luminance. The **Low Gain**, **Mid Gain** and **High Gain** parameters allow you to adjust the amount of grain added to the lowlights, midtones and highlights of the image.

Checking the Result

To test that the new grain is the same as the old grain you

can select **Show - Grain Plate**.



Figure 40. Good selection area...



Figure 41. ...producing a good test plate of grain, free of artifacts.

This generates a sheet of grain with the same luminance level as the mean of the sample region. The sample region with the original grain is also displayed. It should be impossible to differentiate between the two regions. Figure 40 shows a good selection area giving a good test plate of grain in Figure 41. Figure 42 shows a poor selection area since it contains image detail. Figure 43 shows the resulting test plate, which clearly highlights the problem.



Figure 42. Bad selection area...

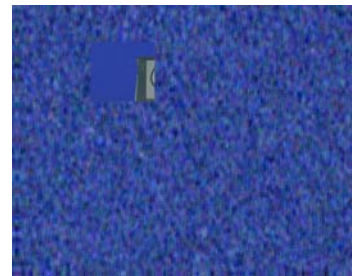


Figure 43. ...producing a poor result.

Parameters

The parameters for this plug-in are described below.

Grain - drag a clip you want to sample grain from into the clip well here. For this to work, **Stock Type** needs to be set to **Sample Grain**.

Stock Type - selects whether the grain is sampled from the grain image (**Sample Grain**) or from a set of standard stocks. 2K, 4K, aperture corrected and non aperture corrected stocks are supplied.

- **Sample Grain** - samples and reconstructs the grain characteristics from the **Grain** image.
- **<Stock><Exposure><Size>** - grain characteristics sampled from a supplied film stock. Common Fuji and Kodak stocks are supplied. The exposure can be under, over or, if left blank, non aperture corrected. The size is either 2K or 4K pixels. For example, FUJIF500 2K refers to the grain characteristics sampled from a 2K plate of Fuji Film 500 film stock non aperture corrected.

Show - sets whether to render the result or a test image.

- **Result** - shows the image with the grain applied.
- **Grain Plate** - shows a test image with the grain applied. This test image is composed from a section of the input image surrounded by a uniform solid colour sampled from the image with the grain applied (Figure 43). If the inner area is indistinguishable from the outer area, then you have a good grain sample (Figure 41).

Grain Scale - adjusts the size of the grain granules.

Grain Gain - adjusts the brightness of the grain.

Red Gain - sets the brightness of the grain in the red

channel.

Green Gain - sets the brightness of the grain in the green channel.

Blue Gain - sets the brightness of the grain in the blue channel.

Red Scale - adjusts the size of the grain granules in the red channel.

Green Scale - adjusts the size of the grain granules in the green channel.

Blue Scale - adjusts the size of the grain granules in the blue channel.

Low Gain - adjusts the gain of the grain in the lowlights.

Mid Gain - adjusts the gain of the grain in the midtones.

High Gain - adjusts the gain of the grain in the highlights.

View Grain Clip - check this to view the clip in the image well of the **Grain** parameter.

Analysis Center - change the position of the centre of the sample region. Click the button to move the selection area into a new position on the Canvas, or enter new coordinates for the centre point in the coordinates fields.

Sample Size - change the size of the sample area.

Analysis Frame - shows the frame to sample the grain from. You cannot adjust this parameter.

Example

The image used in the following example can be downloaded from our website. For more information, please see “Example Images” on page 1.

Rachael

In this example, we will degrain the image using F_DeNoise and then, using F_ReGrain, sample the grain from the original image and reapply it to the degrained image. Switching between the resulting outputs of F_DeNoise and F_ReGrain will show different grain but with the same characteristics.

Apply F_DeNoise to Rachael.tif. Set **Analysis Method** to **Sample Region** and position the sample region over a plain area.

Now load F_ReGrain using the processed output of F_DeNoise as the clip to add grain to and the original unprocessed image as the **Grain** sample clip. Make sure you have set **Stock Type** to **Sample Grain**. Compare the original to the regrained output of F_ReGrain. Note that although the actual grain differs on both images, the grain characteristics are the same.

APPENDIX A

Release Notes

This section describes the requirements, new features, improvements, fixed bugs and known bugs & workarounds for each release of Furnace.

Furnace 4.0v2

This is a maintenance release of Furnace for Final Cut Pro.

Release Date

November 2008

Requirements

1. Final Cut Pro 6.0.4 or above on Mac OS X.
2. Foundry FLEXIm Tools (FFT 4.0v1 or later) for floating licenses.

New Features

There are no new features in this release.

Improvements

There are no improvements in this release.

Bug Fixes

Fixed instability in plug-ins caused by OS incompatibility with FLEXIm 10.8 licensing module. Upgraded FLEXIm to 10.8.6 for improved Leopard compatibility.

Known Bugs and Workarounds

There are no known bugs.

Furnace 4.0v1

This is the first release of Furnace for Final Cut Pro.

Release Date

September 2008

Requirements

1. Final Cut Pro 6.0 on Mac OS X.
2. Foundry FLEXIm Tools (FFT 4.0v1 or later) for floating licenses.

New Features

There are seven plug-ins in this release.

Improvements

This section will describe improvements to existing features in later versions.

Bug Fixes

This section will describe fixed bugs in later versions.

Known Bugs and Workarounds

There are no known bugs.

APPENDIX B

End User License Agreement

IMPORTANT: BY INSTALLING THIS SOFTWARE YOU ACKNOWLEDGE THAT YOU HAVE READ THIS AGREEMENT, UNDERSTAND IT AND AGREE TO BE BOUND BY ITS TERMS AND CONDITIONS. IF YOU DO NOT AGREE TO THE TERMS OF THIS AGREEMENT DO NOT INSTALL, COPY OR USE THE SOFTWARE.

This END USER SOFTWARE LICENSE AGREEMENT (this "Agreement") is made by and between The Foundry Visionmongers Ltd., a company registered in England and Wales, ("The Foundry"), and you, as either an individual or a single entity ("Licensee").

In consideration of the mutual covenants contained herein and for other good and valuable consideration (the receipt and sufficiency of which is acknowledged by each party hereto) the parties agree as follows:

Section 1. Grant of License.

Subject to the limitations of Section 2, The Foundry hereby grants to Licensee a limited, non-transferable and non-exclusive license to install and use a machine readable, object code version of this software program (the "Software") and the accompanying user guide and other documentation (collectively, the "Documentation") solely for Licensee's own internal business purposes (collectively, the "License"); provided, however, Licensee's right to install and use the Software and the Documentation is limited to those rights expressly set out in this Agreement.

Section 2. Restrictions on Use.

Licensee is authorized to use the Software in machine readable, object code form only, and Licensee shall not: (a) assign, sublicense, transfer, pledge, lease, rent, share or export the Software, the Documentation or Licensee's rights hereunder; (b) alter or circumvent the copy protection mechanisms in the Software or reverse engineer, decompile, disassemble or otherwise attempt to discover the source code of the Software; (c) modify, adapt, translate or create derivative works based on the Software or Documentation; (d) use, or allow the use of, the Software or Documentation on any project other than a project produced by Licensee (an "Authorized Project"); (e) allow or permit anyone (other than Licensee and Licensee's authorized employees to the extent they are working on an Authorized Project) to use or have access to the Software or Documentation; (f) copy or install the Software or Documentation other than as expressly provided for herein; or (g) take any action, or fail to take action, that could adversely affect the trademarks, service marks, patents, trade secrets, copyrights or other intellectual property rights of The Foundry or any third party with intellectual property rights in the Software (each, a "Third Party Licensor"). Furthermore, for purposes of this Section 2, the term "Software" shall include any derivatives of the Software.

Licensee shall install and use only a single copy of the Software on one computer, unless the Software is installed in a "floating license" environment, in which case Licensee may install the Software on more than one computer; provided, however, Licensee shall not at any one time use more copies of the Software than the total number of valid Software licenses purchased by Licensee.

Furthermore, the Software can be licensed on an "interactive" or "non-interactive" basis. Licensee shall be authorized to use a non-interactive version of the Software for rendering purposes only (i.e., on a CPU, without a user, in a non-interactive capacity) and shall not use such Software on workstations or otherwise in a user-interactive capacity. Licensee shall be authorized to use an interactive version of the Software for both interactive and non-interactive rendering purposes, if available.

Finally, if the Software is an "Educational Version," Licensee may use it only for the purpose of training and instruction, and for no other purpose. Educational Versions of the Software

may not be used for commercial, professional or for-profit purposes.

Section 3. Back-Up Copy.

Notwithstanding Section 2, Licensee may store one copy of the Software and Documentation off-line and off-site in a secured location owned or leased by Licensee in order to provide a back-up in the event of destruction by fire, flood, acts of war, acts of nature, vandalism or other incident. In no event may Licensee use the back-up copy of the Software or Documentation to circumvent the usage or other limitations set forth in this Agreement.

Section 4. Ownership.

Licensee acknowledges that the Software and Documentation and all intellectual property rights relating thereto are and shall remain the sole property of The Foundry and the Third Party Licensors. Licensee shall not remove, or allow the removal of, any copyright or other proprietary rights notice included in and on the Software or Documentation or take any other action that could adversely affect the property rights of The Foundry or any Third Party Licensor. To the extent that Licensee is authorized to make copies of the Software or Documentation under this Agreement, Licensee shall reproduce in and on all such copies any copyright and/or other proprietary rights notices provided in and on the materials supplied by The Foundry hereunder. Nothing in this Agreement shall be deemed to give Licensee any rights in the trademarks, service marks, patents, trade secrets, copyrights or other intellectual property rights of The Foundry or any Third Party Licensor, and Licensee shall be strictly prohibited from using the name, trademarks or service marks of The Foundry or any Third Party Licensor in Licensee's promotion or publicity without The Foundry's express written approval.

Section 5. License Fee.

Licensee understands that the benefits granted to Licensee hereunder are contingent upon Licensee's payment in full of the license fee payable in connection herewith (the "License Fee").

Section 6. Taxes and Duties.

Licensee agrees to pay, and indemnify The Foundry from claims for, any local, state or national tax (exclusive of taxes based on net income), duty, tariff or other impost related to or arising from the transaction contemplated by this Agreement.

Section 7. Limited Warranty.

The Foundry warrants that, for a period of ninety (90) days after delivery of the Software: (a) the machine readable electronic files constituting the Software and Documentation shall be free from errors that may arise from the electronic file transfer from The Foundry and/or its authorized reseller to Licensee; and (b) to the best of The Foundry's knowledge, Licensee's use of the Software in accordance with the Documentation will not, in and of itself, infringe any third party's copyright, patent or other intellectual property rights. Except as warranted, the Software and Documentation is being provided "as is." THE FOREGOING LIMITED WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES OR CONDITIONS, EXPRESS OR IMPLIED, AND The Foundry DISCLAIMS ANY AND ALL IMPLIED WARRANTIES OR CONDITIONS, INCLUDING, WITHOUT LIMITATION, ANY IMPLIED WARRANTY OF TITLE, NON-INFRINGEMENT, MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, REGARDLESS OF WHETHER The Foundry KNOWS OR HAS REASON TO KNOW OF LICENSEE'S PARTICULAR NEEDS. The Foundry does not warrant that the Software or Documentation will meet Licensee's requirements or that Licensee's use of the Software will be uninterrupted or error free. No employee or agent of The Foundry is authorized to modify this limited warranty, nor to make additional warranties. No action for any breach of the above limited warranty may be commenced more than one (1) year after Licensee's initial receipt of the Software. To the extent any implied warranties may not be disclaimed under

applicable law, then ANY IMPLIED WARRANTIES ARE LIMITED IN DURATION TO NINETY (90) DAYS AFTER DELIVERY OF THE SOFTWARE TO LICENSEE.

Section 8. Limited Remedy.

The exclusive remedy available to the Licensee in the event of a breach of the foregoing limited warranty, TO THE EXCLUSION OF ALL OTHER REMEDIES, is for Licensee to destroy all copies of the Software, send The Foundry a written certification of such destruction and, upon The Foundry's receipt of such certification, The Foundry will make a replacement copy of the Software available to Licensee.

Section 9. Indemnification.

Licensee agrees to indemnify, hold harmless and defend The Foundry and The Foundry's affiliates, officers, directors, shareholders, employees, authorized resellers, agents and other representatives (collectively, the "Released Parties") from all claims, defense costs (including, but not limited to, attorneys' fees), judgments, settlements and other expenses arising from or connected with the operation of Licensee's business or Licensee's possession or use of the Software or Documentation.

Section 10. Limited Liability.

In no event shall the Released Parties' cumulative liability to Licensee or any other party for any loss or damages resulting from any claims, demands or actions arising out of or relating to this Agreement (or the Software or Documentation contemplated herein) exceed the License Fee paid to The Foundry or its authorized reseller for use of the Software. Furthermore, IN NO EVENT SHALL THE RELEASED PARTIES BE LIABLE TO LICENSEE UNDER ANY THEORY FOR ANY INDIRECT, SPECIAL, INCIDENTAL, PUNITIVE, EXEMPLARY OR CONSEQUENTIAL DAMAGES (INCLUDING DAMAGES FOR LOSS OF BUSINESS OR LOSS OF PROFITS) OR THE COST OF PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES,

REGARDLESS OF WHETHER THE RELEASED PARTIES KNOW OR HAVE REASON TO KNOW OF THE POSSIBILITY OF SUCH DAMAGES AND REGARDLESS OF WHETHER ANY REMEDY SET FORTH HEREIN FAILS OF ITS ESSENTIAL PURPOSE. No action arising out of or related to this Agreement, regardless of form, may be brought by Licensee more than one (1) year after Licensee's initial receipt of the Software; provided, however, to the extent such one (1) year limit may not be valid under applicable law, then such period shall be limited to the shortest period allowed by law.

Section 11. Term; Termination.

This Agreement is effective upon Licensee's acceptance of the terms hereof (by clicking on the "Accept" button) and Licensee's payment of the License Fee, and the Agreement will remain in effect until termination. If Licensee breaches this Agreement, The Foundry may terminate the License granted hereunder by notice to Licensee. In the event the License is terminated, Licensee will either return to The Foundry all copies of the Software and Documentation in Licensee's possession or, if The Foundry directs in writing, destroy all such copies. In the latter case, if requested by The Foundry, Licensee shall provide The Foundry with a certificate signed by an officer of Licensee confirming that the foregoing destruction has been completed.

Section 12. Confidentiality.

Licensee agrees that the Software and Documentation are proprietary and confidential information of The Foundry and that all such information and any communications relating thereto (collectively, "Confidential Information") are confidential and a fundamental and important trade secret of The Foundry. Licensee shall disclose Confidential Information only to Licensee's employees who are working on an Authorized Project and have a "need-to-know" such Confidential Information, and shall advise any recipients of Confidential Information that it is to be used only as authorized in this Agreement. Licensee shall not disclose Confidential Information or otherwise make any Confidential Information available to any other of Licensee's employees or to any third parties without the express written

consent of The Foundry. Licensee agrees to segregate, to the extent it can be reasonably done, the Confidential Information from the confidential information and materials of others in order to prevent commingling. Licensee shall take reasonable security measures, which such measures shall be at least as great as the measures Licensee uses to keep Licensee's own confidential information secure (but in any case using no less than a reasonable degree of care), to hold the Software, Documentation and any other Confidential Information in strict confidence and safe custody. The Foundry may request, in which case Licensee agrees to comply with, certain reasonable security measures as part of the use of the Software and Documentation. Licensee acknowledges that monetary damages may not be a sufficient remedy for unauthorized disclosure of Confidential Information, and that The Foundry shall be entitled, without waiving any other rights or remedies, to such injunctive or equitable relief as may be deemed proper by a court of competent jurisdiction.

Section 13. Inspection.

Licensee shall advise The Foundry on demand of all locations where the Software or Documentation is used or stored. Licensee shall permit The Foundry or its authorized agents to inspect all such locations during normal business hours and on reasonable advance notice.

Section 14. Nonsolicitation.

Licensee agrees not to solicit for employment or retention, and not to employ or retain, any of The Foundry's current or future employees who were or are involved in the development and/or creation of the Software.

Section 15. U.S. Government License Rights.

The Software, Documentation and/or data delivered hereunder are subject to the terms of

this Agreement and in no event shall the U.S. Government acquire greater than RESTRICTED/LIMITED RIGHTS. At a minimum, use, duplication or disclosure by the U.S. Government is subject to the applicable restrictions of: (i) FAR §52.227-14 ALTS I, II and III (June 1987); (ii) FAR §52.227-19 (June 1987); (iii) FAR §12.211 and 12.212; and/or (iv) DFARS §227.7202-1(a) and DFARS §227.7202-3.

The Software is the subject of the following notices:

* Copyright (c) 2007 The Foundry Visionmongers, Ltd.. All Rights Reserved.

* Unpublished-rights reserved under the Copyright Laws of the United Kingdom.

Section 16. Survival.

Sections 2, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 17 and 18 shall survive any termination or expiration of this Agreement.

Section 17. Import/Export Controls.

To the extent that any Software made available hereunder is subject to restrictions upon export and/or reexport from the United States, Licensee agrees to comply with, and not act or fail to act in any way that would violate, the applicable international, national, state, regional and local laws and regulations, including, without limitation, the United States Foreign Corrupt Practices Act, the Export Administration Act and the Export Administration Regulations, as amended or otherwise modified from time to time, and neither The Foundry nor Licensee shall be required under this Agreement to act or fail to act in any way which it believes in good faith will violate any such laws or regulations.

SECTION 18. MISCELLANEOUS.

This Agreement is the exclusive agreement between the parties concerning the subject matter hereof and supersedes any and all prior oral or written agreements, negotiations, or other dealings between the parties concerning such subject. This Agreement may be modified only by a written instrument signed by both parties. If any action is brought by either party to this Agreement against the other party regarding the subject matter hereof, the prevailing party shall be entitled to recover, in addition to any other relief granted, reasonable attorneys' fees and expenses of litigation. Should any term of this Agreement be declared void or unenforceable by any court of competent jurisdiction, such declaration shall have no effect on the remaining terms of this Agreement. The failure of either party to enforce any rights granted hereunder or to take action against the other party in the event of any breach hereunder shall not be deemed a waiver by that party as to subsequent enforcement of rights or subsequent actions in the event of future breaches. This Agreement shall be governed by, and construed in accordance with English Law.

Copyright (c) 2008 The Foundry Visionmongers Ltd. All Rights Reserved. Do not duplicate.

INDEX

A-Z

A

Anvil 4

E

End User License
Agreement 53

F

F_DeFlicker 1, 5, 29, 35
F_DirtRemoval 11
F_Kronos 17
F_ReGrain. 43
Filmic Response 46
flicker 1

I

Installing Furnace 2

K

Keylight 4

L

Licensing Furnace 3

M

Motion Blur 19
motion vectors 17

N

Network rendering 3
Nuke 4

R

Release Notes 51
re-timer. See Kronos. 17

T

The Foundry 4
Tinderbox 4

W

web site 4
www.thefoundry.co.uk 4