

# PFMatch™

Version 2.0 For Shake Manual

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#### PFMatch™ v2.0 for Shake - User Manual

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# Introduction

## What is PMatch 2.0 for Shake?

PMatch 2.0 incorporates technology from the market leading tracking and analysis system PTrack to provide Shake users with a fully integrated 3D camera tracking environment to complement Shake 4.0's new 3D environment. The addition of the Pixel Farm's 3D camera tracking engine to Shake 4.0 gives Shake users access to the best 3D camera tracker in any current compositing system on any platform.

Using Match 2.0 Shake users will be able to track shots to determine 3D camera motion and metric and use these within Shake when compositing. For many shots this will end the need for external match moving software. The simple user experience is in contrast to the complex underlying analysis system that provides extremely accurate camera data on any type of moving image solving all types of camera movement and fixed and variable focal lengths.

**Note: At present PMatch 2.0 does not support output to The Pixel Farm's Shake Plug-ins. To use The Pixel Farm Plug-ins you will need to output data from PTrack**

## Who should use PMatch for Shake?

In short, PMatch for Shake is for any Shake user interested in matching computer graphics to digital video footage. It has been designed to be very easy to use for those new to match moving effects. It is an ideal tool for 2D professionals wanting to learn about camera tracking but without the resources or need for a professional stand alone system. PFDump can be used in addition to PMatch allowing you to export both the PMatch camera to 3D systems such as Maya or 3DS Max as well as providing a means to export the Shake MultiPlane node camera. These cameras can be provided to the CG department for matching animation.

## How does PMatch work?

PMatch works by recreating a three dimensional world using the movement of the camera, and then passes this 3D camera animation to the MultiPlane node. It does this by automatically placing a number of tracking points within a frame and tracking these to the next frame. This is repeated until either the tracking marker can no longer be located or you get to the end of the sequence. If the software loses a tracking point then it will add another and carry on. When it reaches the end of the sequence, PMatch performs the reverse action and tracks back through the sequence to match up the points. Don't worry about where it places points - this is an automated process.

Once this has taken place the next stage is to calibrate these points, or convert them into points in 3D space. This is done by working out the movement of points relative to each other using the principle of parallax. Once calibrated, the tracked points become a 3D point cloud that can be used within Shake or exported along with the animated camera to a 3D animation application using PFDump.

Within your 3D system you use the imported camera to view your computer graphics or animation and use the point cloud as a guide to the placing of objects within the video sequence. Once rendered and exported, your computer graphics can then be composited back together with the original footage. As all the camera movement and optical properties have been matched from the original footage the new elements should match exactly. This process is often called match moving, and is the basis for many visual effects in feature films and television shows.

## Real World vs. 3D World

One consideration you have to make when combining elements generated by computer with real world footage is camera distortion. Elements produced in any 3D system and rendered out have no optical distortions, and this means that parallel lines will always be parallel. This is not often the case with video footage. The amount of distortion produced when filming is a characteristic of the lens type and quality. As a rule, the wider the angle of the lens used, the worse the distortion will be. This is simply the result of optical distortion in consumer level cameras. This can be made worse by a cheap lens whose optical qualities may be poor to start with. If you try and match computer graphics to footage shot with a wide angle lens you will get some very funky results. If your footage contains lens distortion then use Shake's tools for correcting this before passing the footage to PFMatch.

## Moving Cameras

In order for PFMatch to work you need to have some camera movement within a shot. For the purpose of tracking, camera movement can be categorised in two different ways, Free Motion and Pan.

Free Motion is just what it says: a camera moving in all directions, a hand held shot produced by walking down a street, or a dolly shot would be good examples of this. In most cases this is the kind of shot you will be using.

A Pan, sometimes called a Nodal Pan or Nodal Shot is a shot in which the camera remains in a fixed position, for example on a tripod, but can still rotate around this point.

The other factor you need to account for within a shot is Zoom. In general PFMatch is capable of solving or tracking all these types of shot, including those where the camera is zooming in or out. Of course there will be shots you cannot track in PFMatch because they require more careful tuning and PFMatch has a limited amount of user intervention within the Shake application environment. If you find this is a common issue with the type of shots you are working with you upgrade to the Pixel Farm's high end stand alone application, PFTrack. This provides a great deal of control over how you can solve a shot and includes additional methods of tracking including Geometry based tracking. Having said that, if you read this you should know how to get shots that will track well and to spot ones that will never track.

For shots to track in well in, you need to have well defined elements within the shot and distinct movement between the background and foreground. If you have a very foreshortened shot or are trying to track against a very neutral background you may have problems. An example would be tracking against a solid coloured wall, or as a worse case, against a green or blue screen without any tracking markers. In this case it is important to add some tracking markers in the background and foreground to provide the software with something to lock onto when trying to place features. If you know you are going to try and track a shot, a little forward planning goes a long way in these cases.

## Going further...

If you want to know a little more about the subject of effects in general, or camera tracking in particular, there are a number of very good books on the subject as well as numerous Web based forums. Please register on the PFHoe Forum at <http://www.thepixelfarm.co.uk/Forum/default.aspx> as this is a good place to ask questions and benefit from everyone else's knowledge. Our software developers and algorithm designers regularly log on to the forums, so if you have any tricky questions, fire away!

# Getting Started

## Installation and System Requirements

In most cases you will receive your copy of the software as a download. The principle of installation the same for a downloaded version of the software as it is for a copy provided on CD. In this section we look at the installation of a 'node locked' version of PFMatch. This ties the software to a single machine using hardware based keys.

To use PFMatch for Shake you will need be running Shake 4.0 on either Mac OS X or Linux.

## Licensing PFMatch

PFMatch requires a license in order to run, the license is a simple text file that will be sent to you once you have purchased the software. The file license lives inside the Pixel Farm folder and is locked to a particular machine. This means if you move your software to a new machine it will not work. Your license will be sent as a text file called 'license.txt' and all you have to do is save this in the Pixel Farm folder and off you go. It is important not to alter the format or name of the license file, as this will stop it working.

To obtain a license you will need your Pixel Farm Host ID. This is not the same as the FlexID, MAC or Ethernet address but is a unique number PFMatch uses to identify your machine. In order to find your Host ID you can simply run PFMatch after installation. An error message will be displayed containing your PFHost ID. You can copy-and-paste your Host ID from this message in order to apply for your license.

## Workflow

PFMatch slots seamlessly into the Shake 4 workflow without the need to actually leave the application. The track data is passed straight to the Shake MultiPlane node, and requires no saving or exporting of data. As you are working in the tree, there is no duplication of footage required, radically reducing facility storage requirements.

## Overview of calculation process

Attach an image sequence you wish to camera track to the 'Image' input of a PFMatch node. Press the 'Track it!' button and wait. Analysing the image sequence to obtain the camera motion can take some time and a line of status text will show the progress of the calculations. Note that if you interact with Shake in any way while the calculations are running, such as pressing a key or mouse button, then the calculations will abort and no results will be obtained.

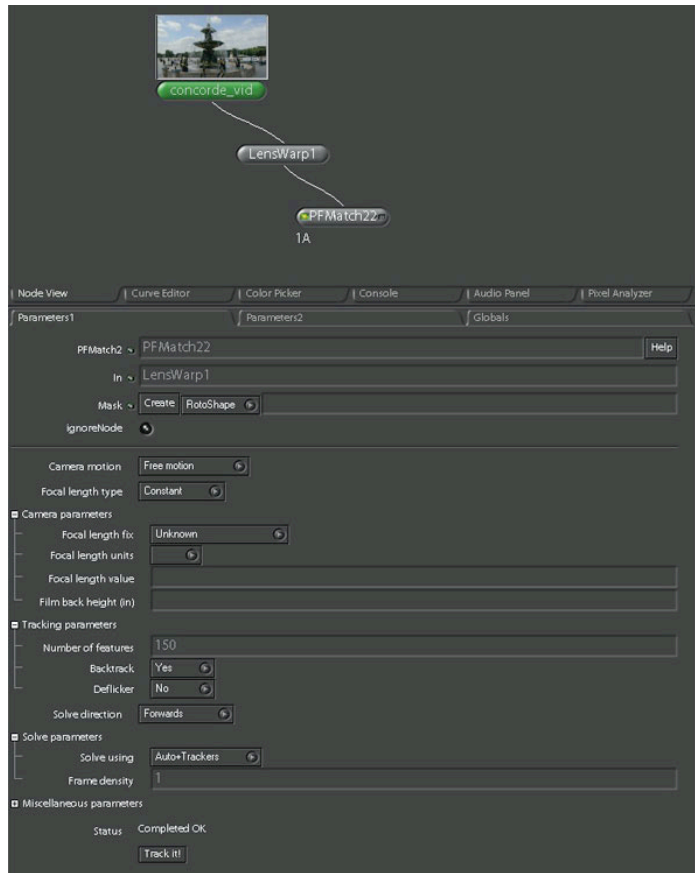
Upon successful completion of the calculations the status text should read 'Completed OK'. To view the camera data insert a MultiPlane node immediately downstream of the PFMatch node. From the MultiPlane's 'mp\_plugins' add a 'PFMatchImport' plugin. A new camera, 'PFMatchCamera', will be created in the MultiPlane node and set as the render camera. Typically you would then switch the 'camera1' view to view through the newly created camera; attach the image layer to the camera; and possibly use the 'Scene scale' option to shrink the effective size of the point cloud for clarity.

## Inputs

The image sequence to be tracked must not undergo any manipulation that would break the underlying camera motion model that PFMatch is trying to find. For example, if the image sequence is heavily warped then no camera path can be calculated that would fit the motion of the now distorted sequence. The one exception to this is warping the image to remove the effects of lens-distortion. Even apparently innocuous operations such as cropping or resizing can break the underlying camera model. Image enhancement operations such as contrast adjustment are OK and may even help PFMatch if they expose more detail in the sequence to be tracked.

An optional second image-sequence can be connected to the PFMatch node through the 'Matte' input. The alpha channel of this sequence is used to matte

out areas of the main image sequence that you do not want tracked. Typically this would be used to matte out moving objects in the image sequence to be tracked. This is the first thing to try if you find your shots do not track as you would expect. The software can be confused if a sequence has a great deal of motion that is different to the general movement of the camera. If objects are close to the camera this can also cause problems.



## General parameters

The 'Time range' setting defaults to that of the image sequence and describes the range of frames from the sequence to be tracked. It is very important to make sure that the general parameters are set correctly. It is often the case that incorrect settings are the reason for failed or poor tracks.

The 'Camera motion' drop down allows you to set the type of camera motion within your sequence. There are two basic types of motion supported within PFMatch for Shake.

**Free motion** - specifies that the camera motion is potentially undergoing translation, rotation and zoom. Typically a hand held, or steady cam shot will be free motion.

**Pan/Tilt/Zoom** - specifies that the camera motion is a nodal pan (rotation and zoom only, no translation). Typically a tripod mounted camera will be a nodal pan.

The 'Focal length type' drop down menu allows you to set the focal length type. The focal length will either be Constant ie. no zoom or Varying, a shot with a zoom. You can sometimes have a shot that look like it has constant focal length but has a slight zoom. If you do not get the results you expect try changing this setting. If you set the focal length to constant the you will have access to the following additional camera settings.

## Camera parameters

A number of values can be set relating to the camera itself. Again it is important to provide the software with accurate information. As well as the focal length type you can also specify whether the focal length is known, unknown or approximately known, and enter the focal length value and units. If you want to enter a focal length in millimetres, make sure that the camera film back size is specified correctly. Setting the focal length can be done in three ways:

**Unknown** - Specifies that the focal length of the lens is unknown.

**Known** - Specifies that the focal length of the lens is an exact known value specified below.

**Approximately known** - Specifies that the focal length of the lens is approximately known and specified below.

If the above is set to 'Known' or 'Approximately known' then the focal length can be set in the 'Focal length value' box. The units of this number are specified by the next parameter.

The 'Focal length units' parameter can be set to use either millimetres or Pixels. If this option is used a film back height, specified below, must be set.

The 'Film back height' sets the film back height of the camera in inches. This only needs to be set if using the millimetre option of the above parameter.

## Tracking parameters

'Number of features' sets the target number of auto-features that PFMatch uses in each frame to determine camera motion. Increasing this number can give more accurate results at the expense of running time but increasing this amount too much can reduce accuracy as an increasing percentage of error is introduced.

If 'Backtrack' is set to 'Yes' tracking points are tracked backwards during a second tracking pass. Performing this step gives a more accurate result at the expense of running time.

'Deflicker' is set to 'No' as a default. Setting this to 'Yes' will allow PFMatch to compensate for any significant contrast/brightness changes between frames.

## Solve parameters

There are a number of parameters that can be set up to affect the way PFMatch solves camera motion once the shot has been tracked. The 'Solve using' has three options:

**Auto+Trackers** - Use a combination of auto track features and Shake 2D features to solve the shot.

If a Shake Tracker node is placed immediately upstream of the PFMatch node then any 2D feature tracks defined there are used by PFMatch in solving the camera motion. This can be used to both guide the calculation process and also to obtain the 3D location corresponding to the 2D tracks (typically used to provide key reference points in the resultant point cloud).

**Auto** - Use auto track features only to solve the shot.

**Trackers** - Use Shake 2D features only to solve shot.

The 'Solve direction' parameter sets the direction used by PFMatch to produce camera motion. If you do not get the results you expect it is worth switching this setting and trying

again as it can have a major effect on the results. The options are:

**Forwards** - Solves the camera from the first frame moving forwards.

**Backwards** - Solves the camera from the last frame moving backwards.

'Frame density' specifies the frame density for the solver. The frame density controls how many frames will be included in the solution. For example, if this is set to '5' then every fifth frame will be solved initially, and the remaining frames will be added to the solution afterwards. Increasing this number can significantly speed up the solution process but potentially at the cost of accuracy.

### Batch parameters

PfMatch can be tightly integrated with PFFarmer, The Pixel Farm's batch processing solution. To use PfMatch with PFFarmer the first 5 parameter shown below specify various PFFarmer configuration information which can be obtained from the person who set up PFFarmer. A full user guide to PFFarmer can be downloaded from the support pages of The Pixel Farm website.

A number of parameters control how PfMatch interacts with PFFarmer.

'PFFarmer machine' is the the machine running PFFarmer and defaults to 'localhost' or the same machine as PfMatch is installed on. 'PFFarmer cluster' is the name of the processing cluster on which to run PfMatch calculations. 'PFFarmer Program' is the name of the application used to process PfMatch calculations 'PFFarmer User' and PFFarmer password are login information to PFFarmer. These 5 variables should only be altered by the PFFarmer sys admin.

The 'Job location' string defines a directory to which various temporary files can be written. The default location is the /tmp directory.

A 'Log file' can be specified for the location of a log file to be written detailing the calculations process. This can be useful when sending information to our support staff.

The 'Block GUI waiting for results' setting allows you to set the way PfMatch behaves while you are working in Shake. If set to 'Yes' any user interaction with the Shake GUI while PfMatch is calculating will cause the calculations to abort and no results will be obtained. If set to 'No' the user can continue interacting with Shake as PfMatch runs in the background. This option is experimental.

### PfMatch Import

The PfMatch node works in conjunction with the PfMatchImport plugin to the MultiPlane node. This plugin is used to import the camera motion and point cloud data calculated by an upstream PfMatch node into the MultiPlane's 3D environment. The controls for this plugin allow for both auto-features and trackers to be used to generate the point cloud, or for each of these to be used individually. A 'Refresh' button is provided to update the camera motion and point cloud data if the PfMatch node is re-run.

## Exporting 3D Cameras from Shake

In order to export 3D data from Shake you need to have PFDump installed on your system. This comes as a separate download from PFMatch and requires a separate license from PFMatch. It can be used with PFMatch to allow full export of 3D camera and point cloud data or on its own to allow the export of the camera from the Shake MultiPlane node. The following formats for exported camera and point cloud data are supported:

- 3DS Max Script
- Adobe AfterEffects
- Combustion Workspace
- Flair MRMC Carts Raw
- Flame/Inferno V5.0 action
- Flame/Inferno V7.0 action
- Flame/Inferno V7.6 action
- Houdini
- Human Readable
- KuperControl ASCII
- Lightwave LWS
- Maya Ascii 4.5
- PFTrack camera data
- Shake Camera
- Softimage XSI

## Using PFDump

To use PFDump place the node immediately downstream of a MultiPlane node. Set the render camera in the MultiPlane node to be the camera you wish to export. Select an export format and filename in the PFDump node and press 'Export'. The status text indicates the success or otherwise of the operation.

The PFDump node contains a control that specifies which items of the point cloud are exported. Options are 'All', 'Selected' and 'None'. The MultiPlane's PFMatchImport plug-in has further controls to refine the point cloud so that it contains all available features, just as automatically created features, or just features corresponding to Shake Tracker nodes.

A scaling factor which is applied to the exported camera position and point cloud positions can be specified essentially giving you control over the scene scaling.

