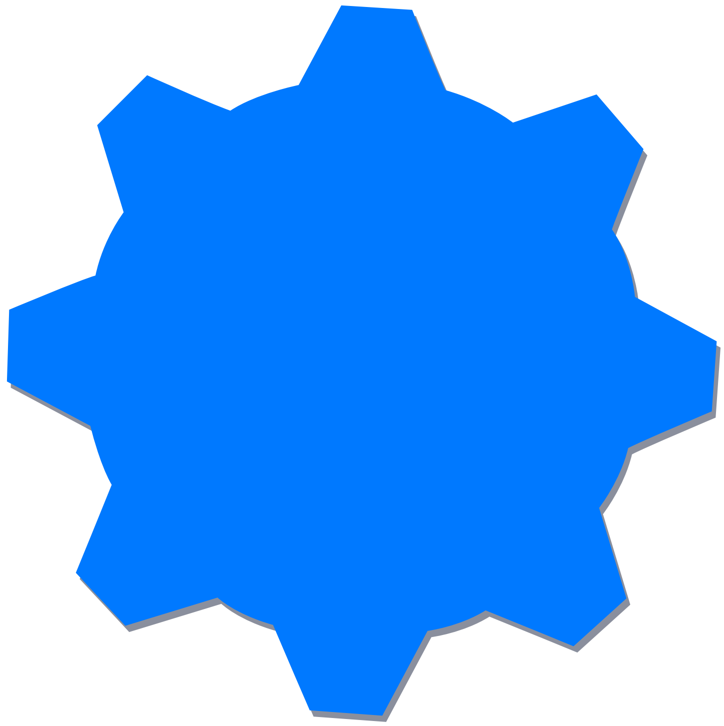
REALVIZ



MatchMover Full Tutorial

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TRADEMARKS

MatchMover™ – the first product of the Image Processing Factory™

MatchMover is the best "3D Camera Tracker" available and the only one running stand alone under both Windows NT® and IRIX®. Using new, breakthrough technology, MatchMover captures any live-action camera motion in 3D (including zoom) by tracking 2D features in an image sequence. No additional information is required about the camera or the scene. In addition, MatchMover calculates the 3D coordinates of any 2D features. By exporting the camera data to standard animation software, users can create image sequences of 3D scenes using the real live-action camera path. For mixed 2D and 3D motion animation, MatchMover is indispensable!

The Image Processing Factory™

The Image Processing Factory is an integrated family of applications that streamline workflow processes for computer graphics professionals involved in image processing, 3D modeling, animation or special effects. With the Image Processing Factory, computer graphics professionals can free their imagination and create!

Other REALVIZ Products

ReTimer™

ReTimer is the ultimate "Time Warper" to slow down or speed up motion sequences. The software utilizes a revolutionary new method for creating new frames between actual frames in a motion or still sequence. With this technique, superior-quality high speed and slow speed sequences can be produced in less time and at lower cost. In addition, ReTimer enables animators to smooth the motion of hand drawn or computer-generated animation sequences by increasing the number of frames available for projection. And, fluid motion sequences can be created from a sequence of just a few photos! ReTimer is a highly effective tool that provides new, easier and less expensive ways to produce a variety of motion effects.

ImageModeler™

Instead of modeling complicated geometry, materials and lighting from scratch, ImageModeler allows computer graphics professionals to tap directly into the richness of the real world. The software is the first high-end "Image-Based Modeler" to produce virtual 3D models from photo, video and cinematic images. ImageModeler processes photo images and interprets them to define a model's geometry in 3D wire-mesh. The software then maps textures from the original images onto the wire-mesh. The resulting 3D model is accurate and highly realistic, and it can be produced in less time and at much lower cost that conventional computer modeling techniques.

Stitcher™

Stitcher combines horizontally and vertically overlapping photos into stunning wide-angle, high-resolution images in seconds. Panoramic images up to 360° X 360° can be exported to 2D compositing software for creating high-definition, realistic matte paintings and to 3D software for environment mapping. Of course, Stitcher panoramas can also be exported to ImageModeler for generating 3D models. In addition, Stitcher allows filming in the panoramic image including zoom, pan, tilt and roll camera motion. The resulting image sequences can be directly exported to post-production software packages. Stitcher provides an alternative to on site shooting for producing large background scenes, and it enables animators to work from high-resolution, very wide-angle images. Stitcher is ideal software for reducing production costs.

Contents

Introduction

Who should read this tutorial?

This tutorial has been designed to allow any user of 3D animation software to quickly become familiar with the 3D camera tracking process (also called match moving) using the REALVIZ' MatchMover software. Even if you are familiar with match moving, you should take the time to read this document to understand how MatchMover software works.

What is contained in the tutorial?

Important:

Please note that you have an online version of the MatchMover Reference Guide. You can access it under the Help menu within MatchMover. You may need to refer to the Guide during this tutorial session.

This tutorial includes three sections. Each section is divided into successive steps. For each intermediate step, a project file, or simply project, is supplied (.mmf file). By using these supplied projects, you can move directly to the next step in the tutorial without executing all of the MatchMover processes.

This version of MatchMover is a Full Use license. This license allows you full use of the features of MatchMover AND you can export results for use in animation software without limit.

Tip:

The total size of the data in this tutorial is approximately 350 MB. It is not necessary to copy the data to your local hard disk, you can run it directly from the CD-ROM. However, you can copy the data to your local hard disk if you desire better performance.

To access the data associated with this document, browse the CD-ROM and go to the ***Tutorial*** directory.
The data for the first and second sections are in the ***t1*** subdirectory.
The data for the third section is in the ***t2*** subdirectory.

Goal of this Tutorial Session

The goal of this tutorial work session is to place a 3D computer-generated pencil container onto a desk. The desk scene was previously filmed using a video camera in three different ways: shoulder held without and with zoom and from a tripod with pan. These three image sequences are each used in this tutorial to track camera movement.

The first section, Orbital Camera Motion, is an image sequence created with simple orbital camera motion without zoom. The camera follows an arc of a circle around the scene. The section presents all the steps you need to follow to be able to obtain the camera parameters.

The second section, Orbital Camera Motion with zoom, explains how to capture orbital camera motion with zoom (the camera moves with various focal lengths).

The third section, Camera on a Tripod, explains how to capture camera motion with pan (the camera was on a tripod).

The second and third sections assume you understand the concepts explained in the first section.

Orbital Camera Motion

The goal of this tutorial is to place a 3D computer-generated pencil container onto a desk. The desk scene (without the pencil container) was previously filmed with a shoulder-held PAL video camera without zoom.

To compute and check the 3D camera path, follow these five steps:

1. Track 2D points in the entire image sequence.
2. Define a 3D coordinate system relative to features in the 3D space.
3. Define geometric relationships between points in the 3D space.
4. Compute the 3D camera path and inspect numeric results for error.
5. Insert a 3D object and preview the scene along the computed 3D camera path.

When you are satisfied with your camera tracking results in MatchMover, the camera path and 3D points can be exported directly to animation software including Maya™, 3D Studio Max®, LightWave 3D™ and SOFTIMAGE 3D® formats. With the MatchMover camera data, you can create new animated image sequences using the real live-action camera path. When these sequences are composited with the original live-action footage, they will match perfectly. And, MatchMover's computed 3D points can be used to create accurate mattes for occlusions.

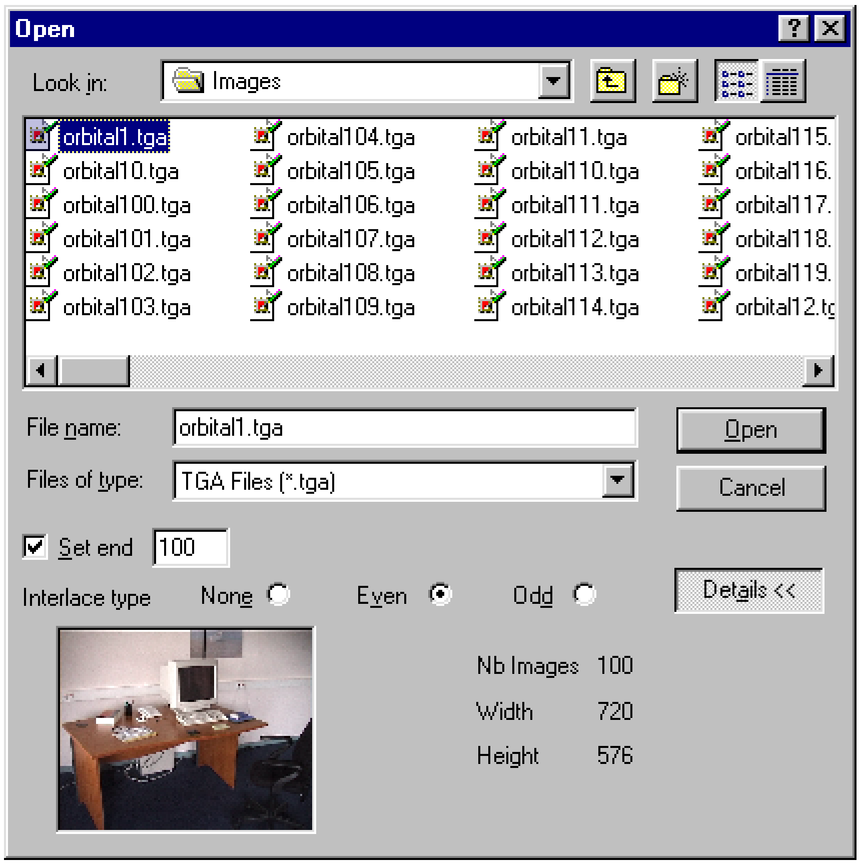
Getting started

1. Launch MatchMover.
   The workspace appears in its default configuration.

2. Select ***File* ➨ *New*** to create a new project.
   MatchMover creates an empty project.

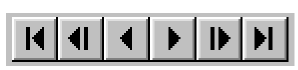
Loading the image sequence

1. Select ***File*** ➨ ***Load Sequence***.
2. Browse the directories to open the Tutorial\t1 directory.
3. In the ***Files of type*** pull down menu, select the targa image format (.TGA).
4. Select the file ***orbital1.tga***.
5. Enable the ***Set end*** check box and set the last frame to the number 100 to load only the first hundred frames.
6. The image sequence was shot with a PAL video camera. Since video formats are interlaced, set the ***Interlace type*** to ***Even***.
7. Click on the ***Open*** button to load the sequence.



By default, MatchMover's workspace is created with an image sequence viewer, called the *2D View*. This viewer allows you to navigate within the sequence by modifying the current time or by pan and zoom.

To learn more about all MatchMover views, refer to the MatchMover Reference Guide, chapter "Quick Reference" ➨ "Windows".

Use the main toolbar to move in the sequence: 
Or, while holding the Ctrl key, press the left arrow key to move to the previous frame. To move to the next, first or last frame, press right arrow, home or end keys, respectively. You can use Ctrl + left mouse to change the time by moving a virtual slider.

Use the View menu to zoom and pan. You can also use shortcut keys as follows:

to pan , use either Alt + left mouse button or the scroll bars;

to zoom out use the minus key (-);

to zoom in use the plus key (+);

to zoom in and out, use Alt + Ctrl + left mouse button.

See the MatchMover Reference Guide, chapter "Quick Reference" ➨ "Windows" ➨ "Navigating within the 2D View Window."

Tracking points in 2D

The pixel pattern in the area around the point you assign is used as a reference template. MatchMover looks for a pixel pattern like the reference template in each successive frame. If the pixel area in the later frames is a sufficiently close match to the reference template, points are tracked accurately. If the pixel area differs significantly from the reference template, the point cannot be tracked well.

Important:

If you only track points that lie in the same plane, results may be poor. It is best to assign points on at least two planes, for example some points on the desk and some on the face of the PC monitor. Ideally, the points you assign will be spaced over the entire volume of the 3D scene.

The points you assign should be points that are easy to distinguish visually. Remember, MatchMover is looking for a very similar pixel area in each successive frame, i.e. pixel areas that can be accurately recognized in each frame. For example, a wall outlet shows a distinctive small, dark pixel pattern that is easy to track because of its high contrast and small size. The points you assign should represent physical points in the scene (e.g. dots, corners of objects or intersections of two bold lines).

Before running the tracking process, study the sequence and select the points you want to track.

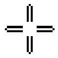
You should not use:

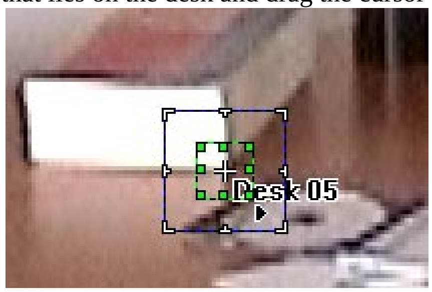
- points not on actual 3D objects like the meeting points of the edges of a foreground and a background object where the two objects overlap visually but do not actually touch.

- points that can not be accurately localized in the image, e.g. points in large, uniform pixel areas or points located along linear edges like the middle of a long line or the middle of a long edge of an object. For example, a point designated in the middle of a long dark edge cannot be easily recognized from a similar one closer to the end of the same dark edge.

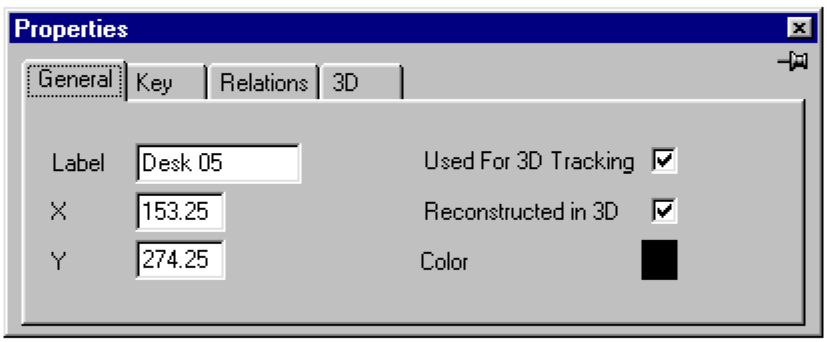
Tracking a point

In the 2D View,

1. Set the current time to the first frame (Ctrl+Home).
2. Click on the right mouse button to open a pop-up menu and select ***NewTrack***. The cursor changes from  to .
3. Click on a corner of the book that lies on the desk and drag the cursor into position.



4. Run the tracker forward (F3). The Tracking Monitor window pops up, displaying the evolution of the tracked pattern through the sequence. If the tracking is successful, the pattern should look stable.
5. You can change the “label” of this point by pressing the ***Alt + Enter*** keys to open the point’s property box. You may want to label each of your points the same way they are labeled in this tutorial.



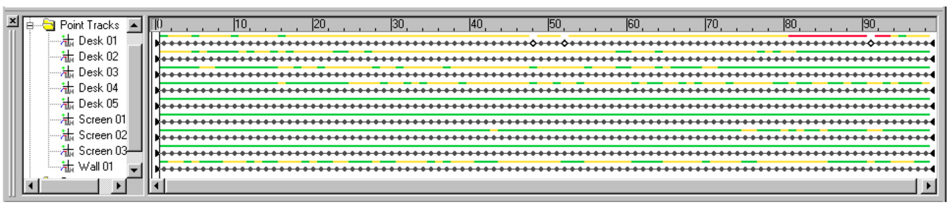
Tip:
*Right click in the 2D View to open the pop-up menu and select the **Lock On Track** mode to keep the selected point track in the center of the view.*

Checking the result

In the Track View, a colored line is displayed above the tracked point. If the line is green, the tracking is good quality. Yellow and red mean fair and poor quality tracks, respectively.

MatchMover allows you to improve on the track by changing the point you assigned to an intermediate key and moving it. MatchMover can also track forward or backward. This process is called bi-directional tracking.

1. In the right pane of the Track View, double click on the point at the time corresponding to the potential problem.
2. If the point has drifted, go to the end of the image sequence and use ***2D Tracking ➨ Set Key*** to change the point to an intermediate key. You can then manually reposition the assigned point so that it matches as accurately as possible to the same point you first assigned.
3. Run bi-directional tracking (F4) to track the point again.



Tip:
When tracking a point that drifts, you should set as many intermediate keys as needed because they improve the accuracy of tracking, You should also set a key at both the first frame and the last frame. Setting these keys and running the bi-directional tracker corrects drift in the point track and improve the overall track quality.

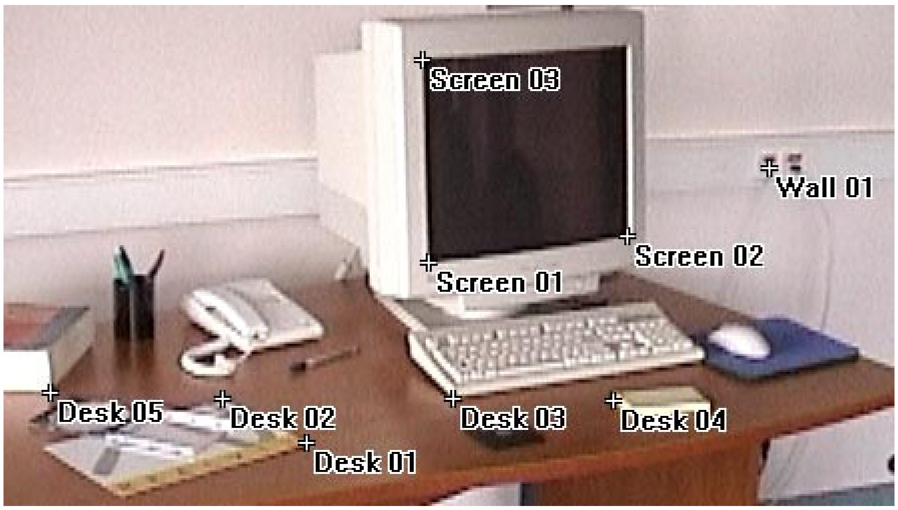
4. Repeat the assign/track process until you have tracked at least 8 points that cover the entire scene. Or, you can continue the tutorial now by using the file ***orbital.rz2*** that contains all the point tracks used in this tutorial.

Importing the 2D points from the first section

1. Select ***File* ➨ *Import*** to open the import dialog box.
2. Select the ***REALVIZ ASCII Point Tracks (.rz2)*** format.
3. Browse the directories and select the file ***Tutorial/ /t1/orbital.rz2***.
4. Click on ***Open***.

The file ***step1.mmf*** contains the project at the end of the point tracking steps.

The picture below shows the nine points that have been tracked in the ***orbital.rz2*** file:



Creating a coordinate system

There are several advantages in defining a system of coordinates in a specific way.

First, the way you define coordinate can make things easier and more intuitive in the next stages. For example, when you insert virtual objects in the scene, they are usually placed on a flat surface like the desk. In this case, it is very convenient to have two coordinate axes, say X and Z, set in the plane of the desk.

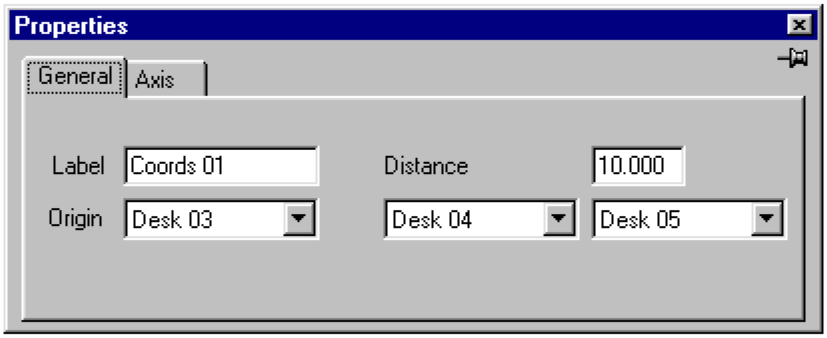
Second, a wisely chosen coordinate system allows you to very easily impose geometric constraints on certain points. These constraints define obvious alignments in the scene that are easy to see. An example of such a constraint might be, "the screen corners are at the same height above the desk, so they should have the same Y coordinate". These constraints help improve the accuracy of tracking and they result in a higher quality composition when 3D objects are mixed with live-action footage.

In this example, you are going to create a coordinate system defining the plane X-Z plane on the desk. The Y-axis is the vertical axis normal to the desk.

> *Tip:*
>
> *Depending upon the 3D-animation package you use, define the axis to either have Y up or Z up. The coordinate axis you define in MatchMover should be the same as the axis in your animation software.*

Setting the origin and the scaling

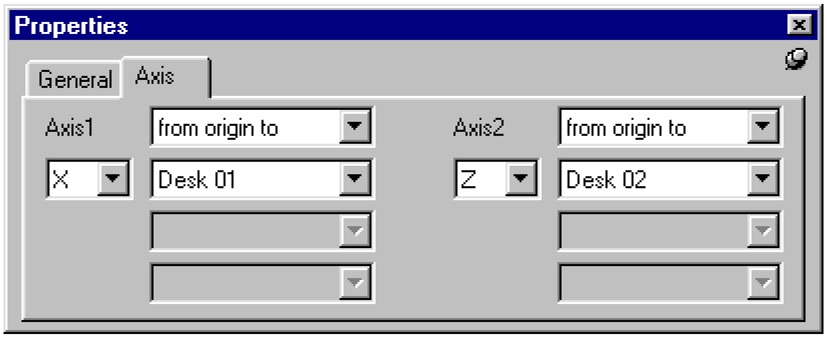
1. In the Project View, right click on the ***Coordinate System*** folder to open the pop up menu. Select the ***New Coordinate System*** item.
2. Double click on the ***Coords 01*** item to open its property box.
3. Set the origin of your coordinate system on the ***Desk 03*** point.
4. Define the distance between two points, ***Desk 04*** and ***Desk 05***, to be 10.0 units. (The distance between two chosen points defines the coordinate system scaling.)



Tip:
*If you set the distance between the points **Desk 01** and **Desk 02** to 22 units, which is the actual width in centimeters of the brochure that is on the desktop, the 3D units will all be in centimeters.*

Defining the axis

1. Open the ***Axis*** page on the Properties dialogue box .
2. Axis1 defines a coordinate axis, X in this example. The axis is defined as a line passing through two points. Usually the origin is chosen along with one other assigned point (***Desk 01***). But, you could choose any two points.
3. You can define Y or Z as the second axis. In this example, we have chosen to define the Z axis ***from origin to*** point ***Desk 02***.



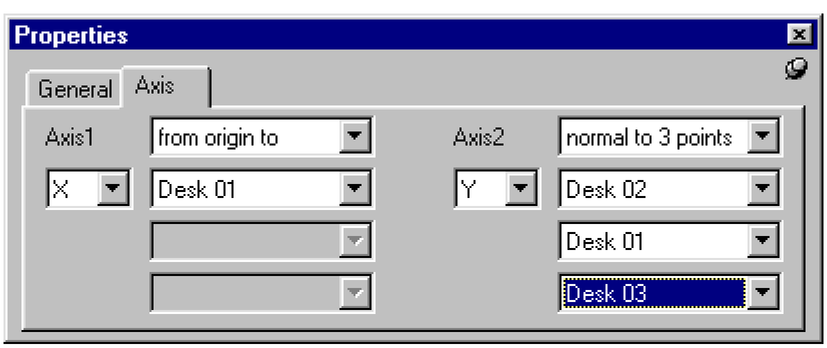
Tip:

The second axis does not need to be orthogonal to the first axis. You may create either orthogonal or non-orthogonal axis for convenience.

4. To define the vertical axis accurately relative to the desk, we can set the axis normal to the plane passing through three points on the desk. For Axis 2, Y, select the item ***normal to three points*** and choose the points ***Desk 01***, ***Desk 02*** and ***Desk 03***. All of these points lie in the plane of the desk defined by the axis X and Z.

Note:

The third axis is automatically defined to be orthogonal to the first two axes.

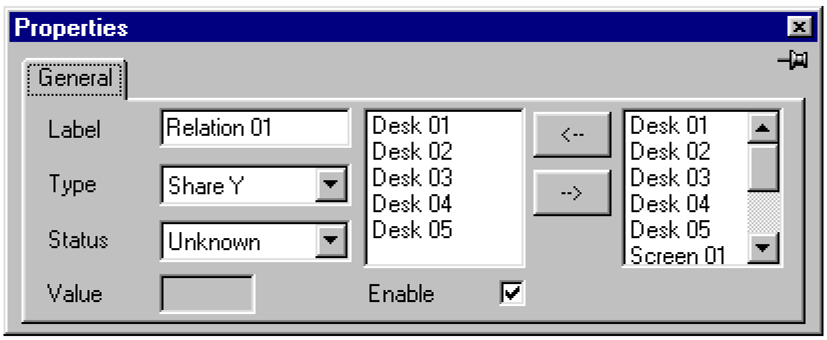


Defining relations between points

MatchMover reconstructs the live-action footage into accurate 3D space. To increase the precision of the reconstruction, you can indicate the position of certain points or the shared constraints of certain points.

In this example, it is obvious that the points ***Desk 01***, ***Desk 02***, ***Desk 03***, ***Desk 04*** and ***Desk 05*** are all at the same height since they are all in the plane of the desk. To set this constraint, do the following:

1. In the Project View, right click on the ***Point Relations*** folder and create a new relation. Or, Double click on the Point Relations to open its property dialogue.
2. Set the type of the relation to ***Share Y***.
3. Select the points ***Desk 01***, ***Desk 02***, ***Desk 03***, ***Desk 04*** and ***Desk 05*** in the rightmost list box.
4. Click on the left arrow button to add the selected points to the list of points sharing the relation. Be sure the Enable box is checked.

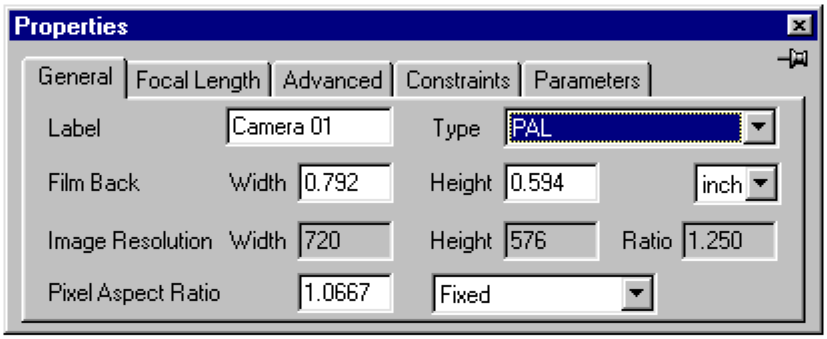


This point relation forces MatchMover to compute these 3D points so that they lie exactly on the same plane, the desk in this example. Without these constraints, MatchMover cannot know these points are in the same plane.

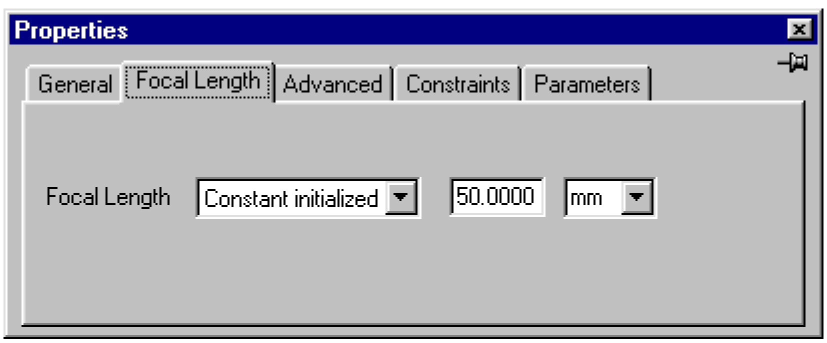
Computing the 3D camera path

Before running the camera tracker you need to define the characteristics of your camera. In this tutorial, you only know that the sequence was shot from a PAL camera without any zoom.

1. In the Project View, open the Cameras folder. Right click on the ***Camera 01*** item and open the Property dialogue.
2. On the General page, select a camera of type PAL.



3. Open the ***Focal Length*** page.
4. Set the focal length to Constant initialized because you know that there is no zoom. Leave the starting value to the default.



5. To be able to easily composite the scene in any 3D package, leave the advanced parameters to their default values (principal point and distortion).
6. Run the camera tracking by either selecting ***3D Tracking*** ➨ ***Track Camera***, by pressing the F9 key or by clicking on the  icon.

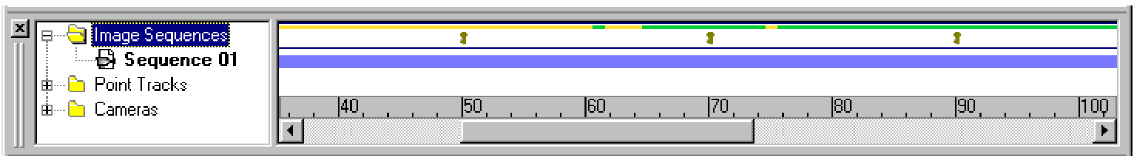
The ***step2.mmf*** file contains the project after the camera tracking process. You can open it in the next section to continue with the tutorial.

Previewing the results

There are two ways to check the quality of the camera tracking results. The first way is to ensure that the reconstructed points are numerically correct. The second way is to inspect the camera path visually.

Numeric check

The numeric check is done by comparing the position of the 2D tracked point to the projected position of the computed 3D point. In the Track View**,** the uppermost colored line indicates the quality of the point tracking. Green is good, yellow is fair and red is poor.



The Survey Views contain more information about the precision of the calculated data.
Select ***Window* ➨ *Survey View*** to display an existing Survey View or ***Window* ➨ *New View* ➨ *Survey*** to create a new one.

The Survey Views allow you to check the results in three ways:

1. For each point, the average deviation of the 2D point position to the 3D computed point position is shown in pixels. If any point has an error clearly greater than the errors of most other points, check the 2D tracking path of this point. If necessary, you can assign new Intermediate Keys and track the point again.

Point	3D Residual
Desk 01	0.2859
Desk 02	0.4809
Desk 03	0.3389
Desk 04	0.2385
Desk 05	0.4352
Screen 01	0.1738
Screen 02	0.2070
Screen 03	0.3559
Wall 01	0.1706

2. To display the frame deviation, ***Display* ➨ *Survey Mode* ➨ *Frames.*** For each frame, the average of the deviation error for all points in the frame is displayed. If a frame has an error clearly greater than those of the other frames, check the position of the 2D points in this frame.

Frame	3D Residual
0	0.7206
1	0.6905
2	0.6952
3	0.6209
4	0.5466
5	0.6089
6	0.5150
7	0.4864
8	0.4916
9	0.4299

3. To display the deviation of each point in each frame, ***Display* ➨ *Survey Mode* ➨ *Points and Frames.*** For each frame the deviation error for each point is shown. It is useful to sort this window

by descending ***3D Residual*** in order to find the points and the images that have been poorly calculated. Click on the header of the ***3D Residual*** column to sort the residuals.

Frame	Point	2D Quality	3D Residual
0	Desk 01	0.8000	0.6778
1	Desk 01	0.9615	0.7458
2	Desk 01	0.9104	0.9188
3	Desk 01	0.8979	0.7130
4	Desk 01	0.8914	0.6106
5	Desk 01	0.9706	0.5582
6	Desk 01	0.8842	0.7324
7	Desk 01	0.8666	0.7261
8	Desk 01	0.8687	0.1736
9	Desk 01	0.9442	0.4270
10	Desk 01	0.9506	0.2424
11	Desk 01	0.9275	0.5279
12	Desk 01	0.8766	0.1764
13	Desk 01	[illegible]	[illegible]

Before exporting the data to the 3D animation package, the final check is visual. You can insert a 3D object into the scene and visually check that it is stable when you run the image sequence. In this example, it is convenient to place an object on the desk by aligning the object on the X-Z plane at Y=0.

Visual check

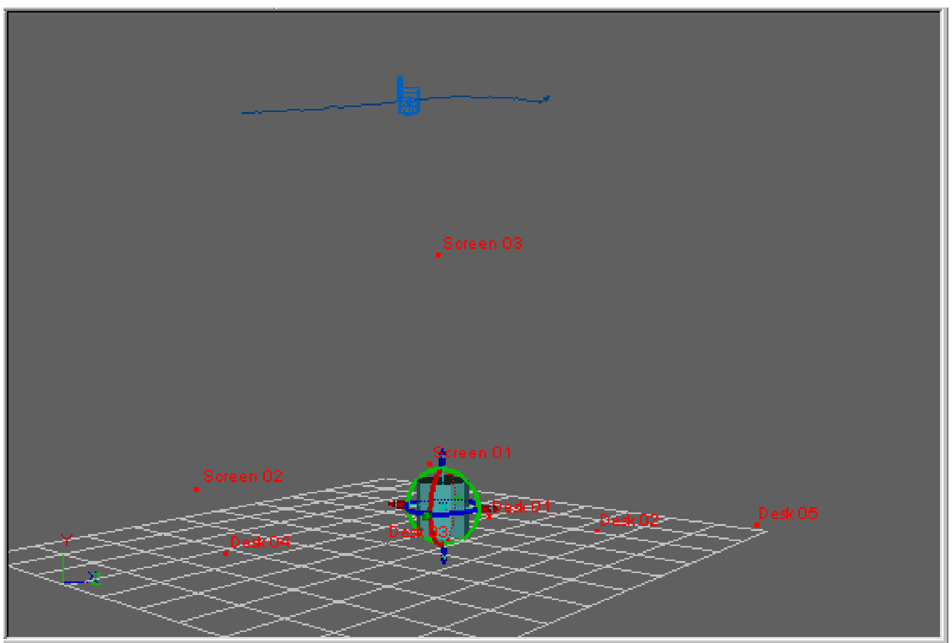
Select ***Window* ➨ *3D View*** to open an existing 3D View, or if none exists, select ***Window* ➨ *New View* ➨ *3D*** to create a new one.

By default, the 3D view opens in Free Camera mode. The viewpoint can be changed to view the 3D scene from any position by panning, rotating, zooming, etc. To review the 3D viewing shortcuts, check the online Reference Guide, chapter “Quick Reference” ➨ “Windows” ➨ “Navigating within the 3D View window: Free Camera Mode”.

To check the match between the real camera and the reconstructed one, insert a 3D object into the scene.

1. Right click in the 3D View to open the pop-up menu.
2. Select ***New Primitive* ➨ *Cylinder***.

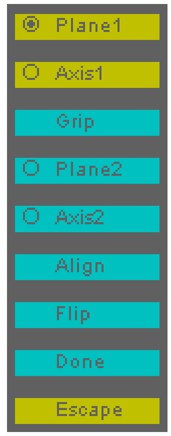
A cylinder is created, centered on the origin of the current coordinate system and surrounded by a manipulator. This manipulator allows you to freely translate, rotate or scale the selected object by clicking on the arrows, the circles or the cylinders, respectively, and dragging the mouse while pressing the mouse button.



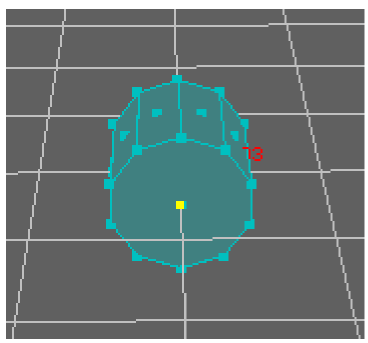
In order to precisely position the object on the desk use the alignment feature described on the next page.

Aligning the object on the desk

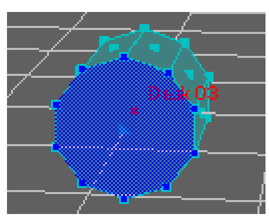
1. Click on the object to select it.
2. Click the right mouse button to open the pop-up menu and select the ***Select Manipulator*** ➨ ***Alignment*** item.
3. A menu appears on the right of the 3D View.



4. Select the small button in the center of the cylinder's base.

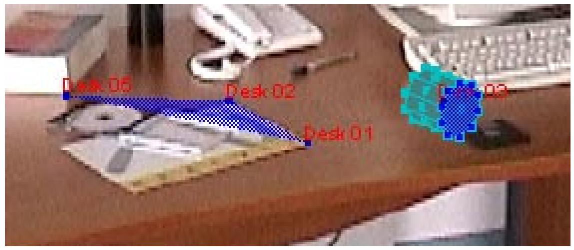


The selected face is highlighted.

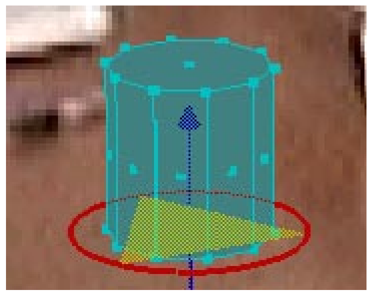


5. Click on the ***Grip*** item in the menu to accept the selection.

6. Select 3 points that lie on the desk to define the plane of the desk.



7. Click on the ***Align*** item in the menu to align the cylinder on the desk. This operation brings the selected face of the cylinder onto the plane of the desk.



8. Depending on the way in which you clicked the 3 points, the cylinder appears correctly or reversed. If it is reversed, click on the ***Flip*** item in the menu to position it correctly on the desk.
9. A new manipulator appears that allows you to move the object in the plane of the desk. Use the circle to turn the object. Use the triangle to move the object while keeping it correctly aligned on the desk. Use the line to move the object vertically.
10. When the object is correctly placed in the scene, click on the ***Done*** item in the menu.

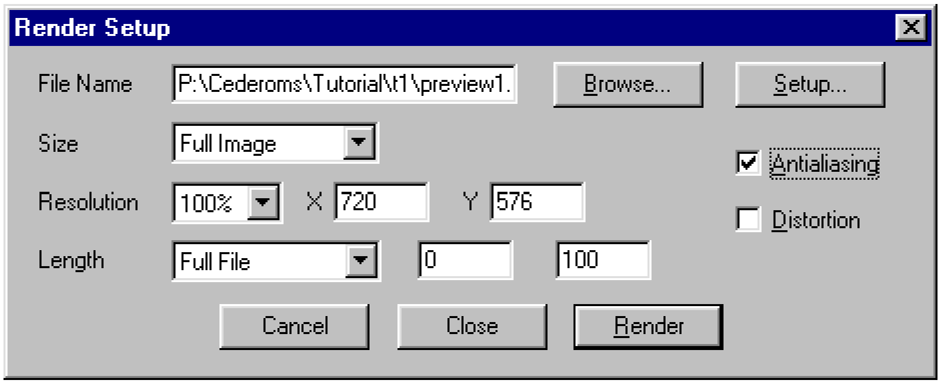
If you wish to preview the results with more complex objects you can use the ***File* ➨ *Import*** menu to import 3D objects of the Wavefront .OBJ format.

> *Note:*
>
> *There are no .obj files included in the tutorial data set.*

To ensure that the 3D objects remain perfectly fixed in position, it is necessary to view the composited images at video rate. This can be achieved by generating a preview sequence in AVI format and replaying it at normal speed.

Generating an AVI sequence

1. Select ***3DScene*** ➨ ***Render Setup*** to open the Render Setup dialog box.
2. Enter the path and the name of the file to generate.
3. Use the ***Setup…*** button to choose a compressor (the default compressor is Microsoft Video 1).
4. Select the output file resolution and the range of frames to render.
5. Enable the ***Antialiasing*** check box to smooth the rendering of the scene.
6. Click on ***Render***.



The sample files preview1.avi and preview2.avi contain results that you can compare to your own.

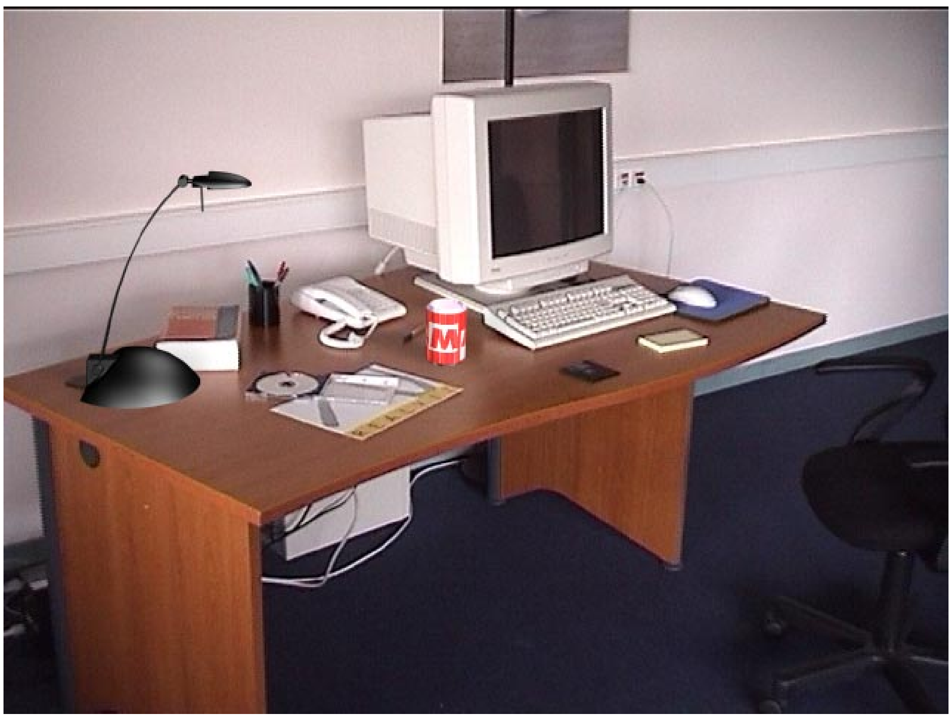
The file ***step3.mmf*** contains the final results of the project for this section of the tutorial.

Exporting the camera path

1. Select ***File* ➨ *Export*** to open the Export dialogue box.
2. Set the type of the file for the desired format (ASCII, 3D Studio Max, SOFTIMAGE 3D, Maya or LightWave 3D).
3. Enter the path and the name of the file.

Refer to the chapter “Exporting” in the MatchMover Reference Guide to understand how to use this exported file in your 3D animation software.

The files ***orbital1.rz3***, ***orbital1.ms***, ***orbital1.xsi***, ***orbital1.ma*** and ***orbital1.lws*** contain the exported data in ASCII, 3D Studio Max, SOFTIMAGE 3D, Maya or LightWave 3D formats, respectively. You can load these files into your animation software to see how this tutorial project will appear after rendering the 3D objects.



Result after rendering in 3D Studio Max.

Orbital Camera Motion with Zoom

The aim of this tutorial is to place a computer generated pencil container on a desk filmed with a moving camera that has a varying zoom during the sequence.
You use the same sequence as the previous section, but you load more frames.

Getting started

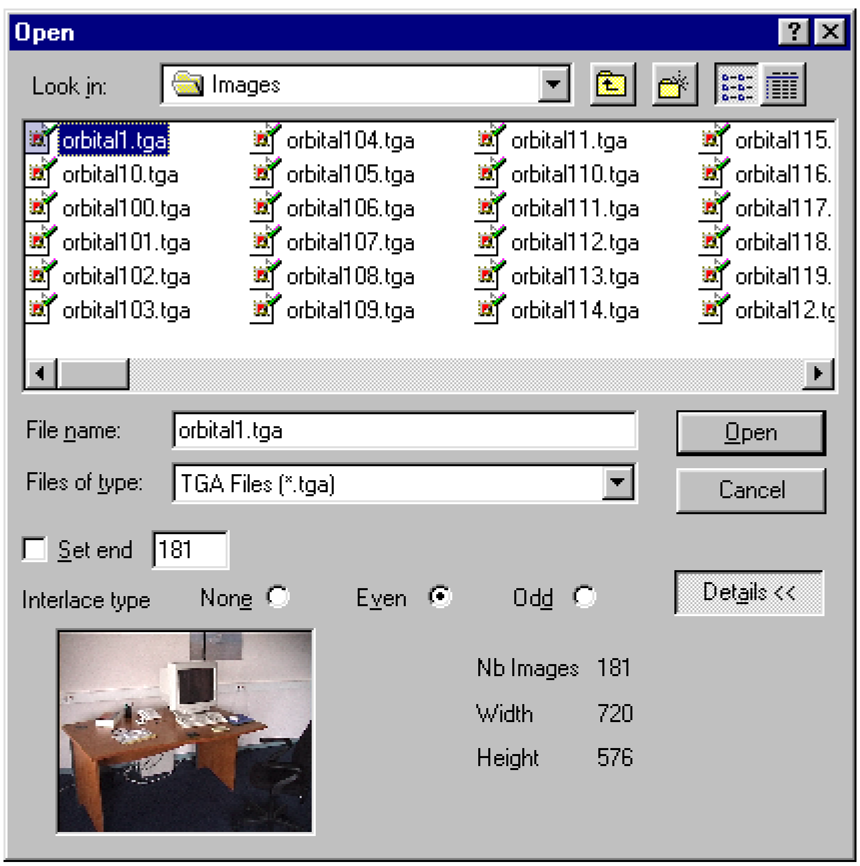
1. Launch MatchMover.
   The workspace appears in its default configuration.

2. Select ***File*** ➨ ***New*** to create a new project.
   MatchMover creates an empty project.

Loading the image sequence

In the ***File*** menu,

1. Select the ***Load Sequence*** item.
2. Browse the directories to open the Tutorial\t1\Images directory.
3. In the ***Files of type*** pull down menu, select the targa image format (.TGA).
4. Select the file ***orbital1.tga***, which is the same sequence as used previously.
5. Select the ***Even*** Interlace type.
6. Click on the ***Open*** button to open all the frames (181). The sequence used here is longer than in the previous exercise. Zoom is present in the later frames.
7. If you don't see the image sequence, make sure you are in 2D View.

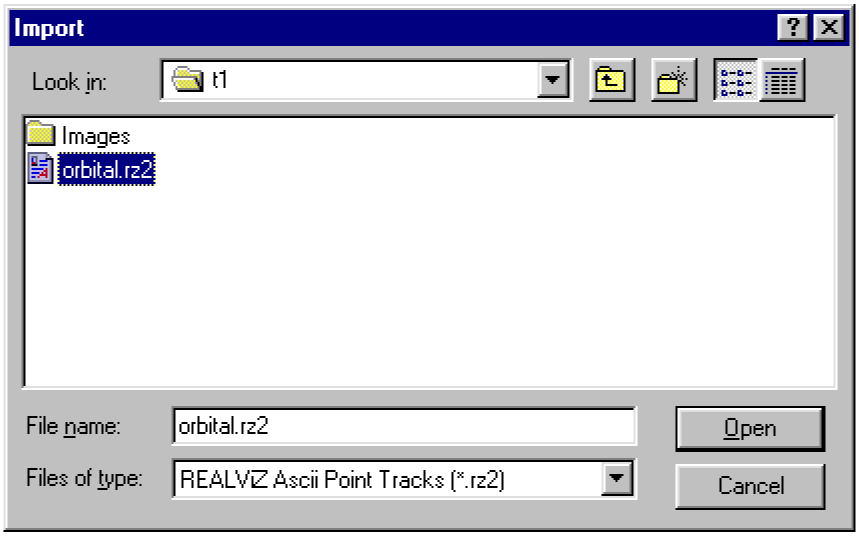


Tracking points in 2D

In the previous section we already tracked 8 points for the 100 first frames. You can either import the file you have previously saved or use the *orbital.rz2* that we have provided (this file contains the points tracked in all the frames). You can also track new points.

Importing 2D points

1. Select ***File*** ➨ ***Import*** to open the Import dialog box.
2. Select the ***REALVIZ ASCII Point Tracks (.rz2)*** format in the t1 directory.
3. Select the <project_name>.rz2 file and open it.

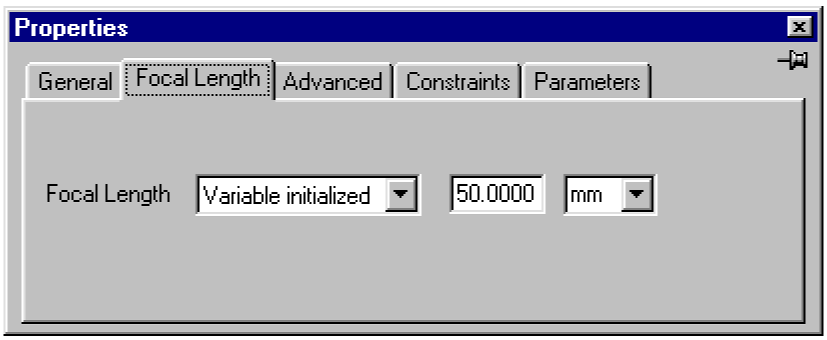


Computing the 3D camera path

Before running the camera tracker you need to define a coordinate system, the point relations and the characteristics of your camera. In this tutorial, you know that the sequence has been shot from a PAL video without any zoom for at least the first 100 frames, and with zoom to the end of the shot.

In the Project View,

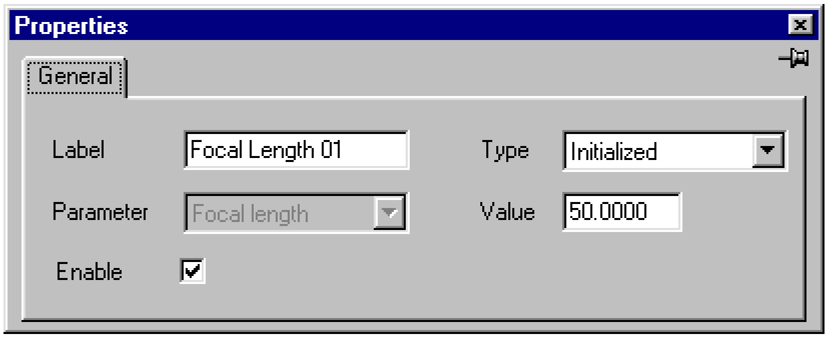
1. Create a coordinate system.
2. Create a point relation for the points that lie on the desk.
3. Right click on the ***Camera 01*** item and open its property panel.
4. Open the ***Focal Length*** page.
5. Set the focal length to ***Variable Initialized*** because you know that there is some zoom variation. Leave the starting value to its default value (50mm).



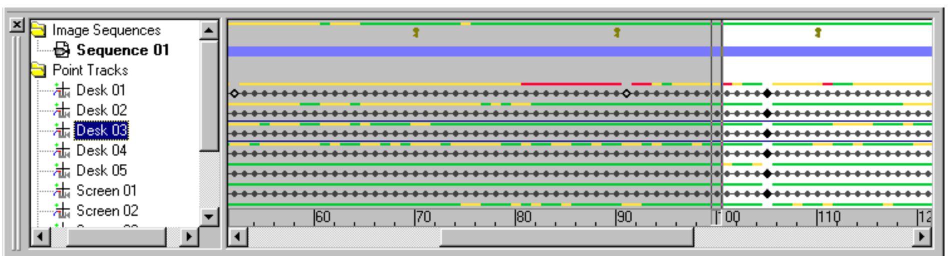
Since we know there is no zoom in the 100 first frames, we now create a camera constraint to provide this information to the camera tracker.

Defining a camera constraint

1. In the Project View, right click on the ***Camera 01*** item and select the ***New Constraint*** item.
2. Open the constraint ***Focal Length 01*** property panel.
3. Set the type of the constraint to ***Initialized***.



4. In the Track View, press the Shift key and click and drag the left mouse to select the 100 first frames of the sequence.



5. Check that the constraint ***Focal Length 01*** is selected (in the Track View).
6. In the right pane of the Track view, right click to open the pop-up menu and select the ***Add Frames*** item to add the selected frames to the current constraint.
7. Press the Shift key and right click in the Track view to reset the time range.

You can now run the camera tracker and check the results.

The file ***step4.mmf*** contains the final results of the project for this section of the tutorial.

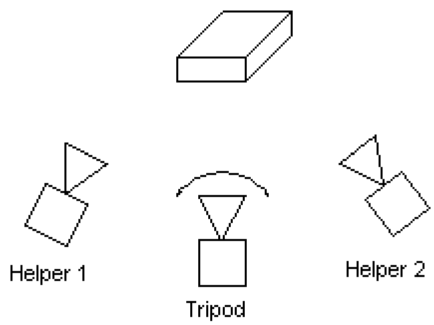
The file preview3.avi contains results that you can compare to your own.
The files ***orbital2.rz3***, ***orbital2.ms***, ***orbital2.xsi***, ***orbital2.ma*** and ***orbital2.lws*** contain, respectively, the exported data in ASCII, 3D Studio Max, SOFTIMAGE 3D, Maya and LightWave 3D formats.

Camera on a tripod

The goal of this tutorial is to place a computer generated pencil container on a desk filmed with a camera on a tripod. There is pan movement in the image sequence.

Camera movement on a tripod or within a travelling motion often creates image sequences with little or no parallax information. By ***parallax*** we mean the apparent relative motion between objects in the foreground and objects in the background.

Some footage may not have sufficient parallax for MatchMover to track points accurately. When the footage does not have sufficient parallax, you can introduce parallax information to the project by importing additional still images shot from different positions on the set. These additional frames are called ***helper frames***.



> *Tip:*
>
> *If you are going to track image sequences with no or little parallax, the best way is with Helper frames. Helper frames are shot in the production stage (like Helper 1 and Helper 2 in the above figure) using a still camera. The Helper frames provide the information required to capture the camera track in the post-production stage when there is little parallax in the live-action footage.*
>
> *If you do not have helper frames, you can use point relations to input 3D measurements of known points in order to provide 3D information to MatchMover. This additional data will enable MatchMover to track points accurately.*
>
> *If you have old footage with little or no parallax and no helper frames, you can still capture camera motion by creating 3D points using point relations. Usually, the location of some points can be discerned by observation. Place these points and track them. Use the editing tools to improve tracking. Check the results by inserting a 3D object and generating an AVI. You may not get perfect results every time, but these camera tracks may still save you time!*

> *Important:*
>
> *If you use point relations to input 3D measurements you must input at least four points that are not coplanar.*

Getting started

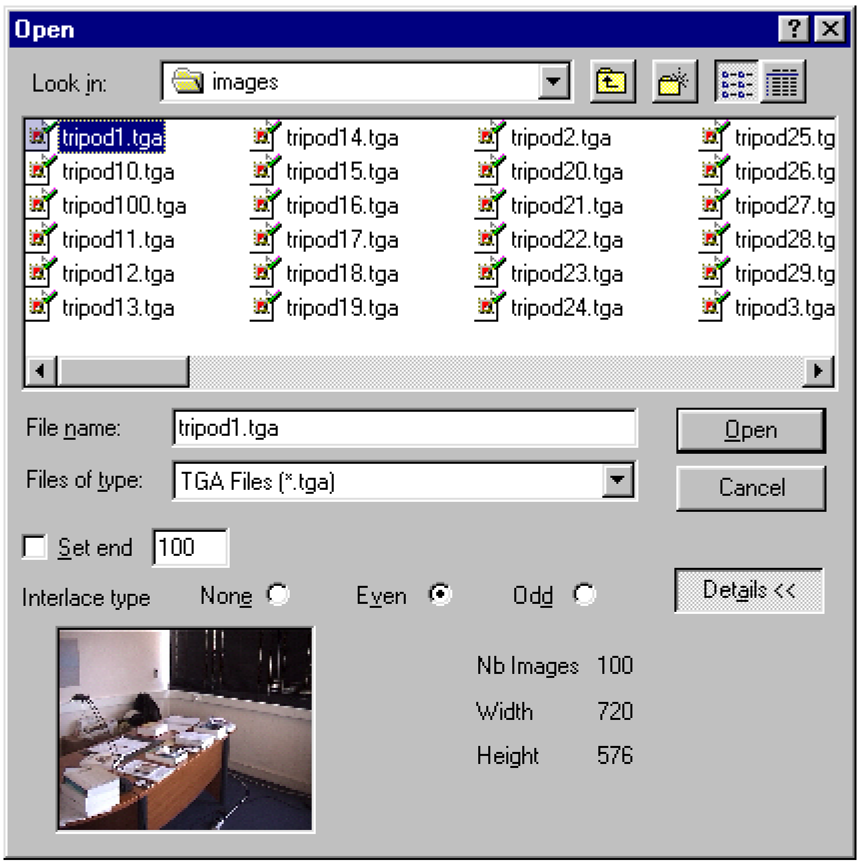
1. Launch MatchMover.
   The workspace appears in its default configuration.

2. Select ***File*** ➨ ***New*** to create a new project.
   MatchMover creates an empty project.

Loading the image sequence

In the ***File*** menu,

1. Select the ***Load Sequence*** item.
2. Browse the directories to open the Tutorial\t2 directory.
3. In the ***Files of type*** pull down menu, select the targa image format (.TGA).
4. Select the file ***tripod1.tga*** and Even Interlace type.
5. Click on the ***Open*** button to open all the frames (100).



Computing the 3D camera path

1. You can either import the tripod.rz2 file we provide or track your own 2D points.
2. Create a coordinate system.
3. Set the parameters of the camera.
4. Run the camera tracker.
5. Open the survey window and check the results, they are probably poor.

> *Tip:*
>
> *Remember that a good result means that the distance between the 2D points and the reconstructed 3D points (the 3D residual) is less than one pixel.*

Because there is not enough parallax in the image sequence, the camera tracker cannot compute the camera parameters. You need to provide more 3D information to the tracker. You can either measure 3D points in the scene and create point relations with fixed point values, or you can add still pictures of the same scene shot from different view points.

In this tutorial session, you are going to import two additional frames shot from different position to introduce parallax information to the project. On a real project, this will be the least expensive option for capturing the information MatchMover needs to track camera motion.

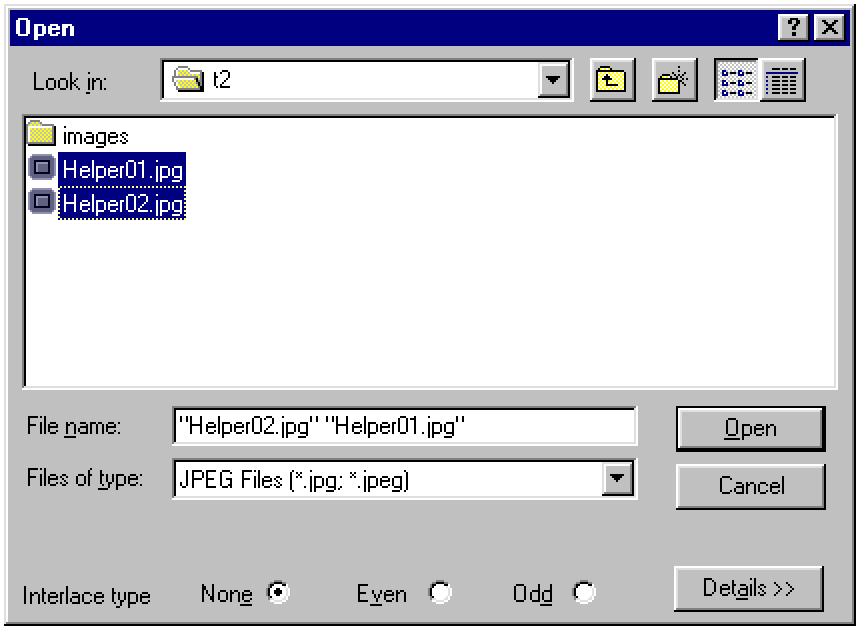
The file ***step1.mmf*** contains the project for the next steps.

Loading the helper frames

The two helper frames used in this tutorial have been shot with the same camera and with the same focal length. When loaded together, the two images share the same camera.

In the ***File*** menu,

1. Select ***Load Images***.
2. Browse the directories to open the Tutorial\t2 directory.
3. In the ***Files of type*** pull down menu, select the jpeg image format (.JPG).
4. Select the files ***helper1.jpg*** and ***helper2.jpg***.
5. Leave the ***Interlace type*** to ***None***.
6. Click on the ***Open*** button to open the two helper frames.



Assigning 2D points

For each point track, assign the 2D point in the helper images.

1. Select a point track.
2. Set the current time in order to display the first helper frame.
3. Click in the helper frame at the corresponding position of this point.
4. Set the current time in order to display the second helper frame.
5. Click in the helper frame at the corresponding position of this point.

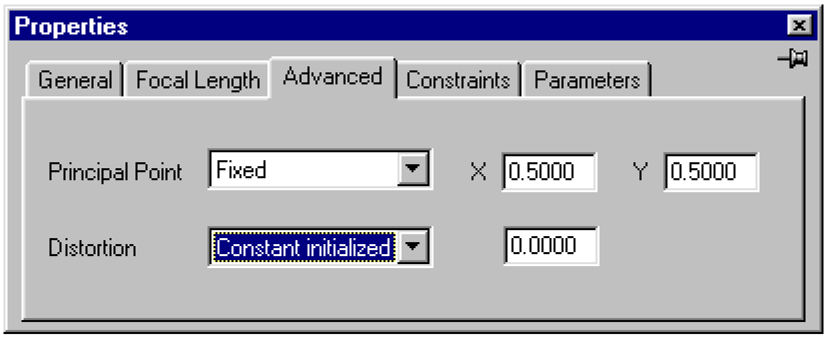
Repeat this process for all the point tracks.

Re-computing the 3D camera path

The digital camera that we used to shoot the two helpers images has generated some non-linear distortion. You can see that straight lines appear slightly curved, especially close to the edges of the image.

Before tracking the camera, modify the settings of the camera to allow the camera tracker to calculate this distortion.

1. Select the camera that has been automatically associated to the helper frames (***Camera 02***).
2. Open its property box (Alt + Enter).
3. Open the ***Advanced*** page.
4. Set the ***Distortion*** parameter to ***Constant initialized***.



5. Repeat the same operation for the camera associated with the image sequence.
6. Run the camera tracker (***F9***).

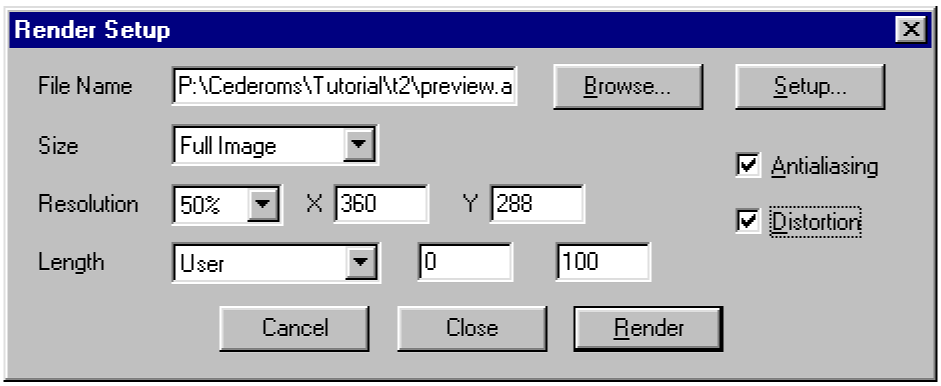
> *Tip:*
>
> *If your 3D-animation package does not allow you to input the distortion value in the render tool, you have to set the distortion type to* ***Fixed*** *and its value to* ***0*** *before running the camera tracker. MatchMover will then find the most satisfactory distortion-free solution to the problem.*

Previewing the results

1. In the Survey View, check the values of the residuals.
2. Open an existing 3D View or create a new one.
3. Create a new 3D primitive.
4. Align it on the desk and check that it stays in position.
5. Generate an AVI sequence to play the composited sequence in real-time.

Generating an AVI sequence with distortion

1. Select ***3DScene*** ➨ ***Render Setup*** to open the Render Setup dialog box.
2. Enter the path and the name of the file to generate.
3. Use the ***Setup…*** button to choose a compressor (the default compressor is Microsoft Video 1).
4. Select the output file resolution and the range of frames to render.
5. Enable the ***Antialiasing*** check box to smooth the rendering of the scene.
6. Enable the ***Distortion*** check box to render the 3D scene with the computed distortion of the camera.
7. Click on ***Render***.



Note:

In the 3D View, the background image is slightly deformed to compensate for distortion (see the edges of the image).

In the AVI sequence, 3D objects are deformed slightly while the image background remains normal.

The file ***step2.mmf*** contains the final results of the project for this section of the tutorial.

The file preview.avi contains results that you can compare to your own.
The files ***tripod.rz3***, ***tripod.ms***, ***tripod.xsi***, ***tripod.ma*** and ***tripod.lws*** contain, respectively, the exported data in ASCII, 3D Studio Max, SOFTIMAGE 3D, Maya and LightWave 3D formats.