

# AnimaTek's CameraMaker Plug-In

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## The CameraMaker Package

The CameraMaker Package contains:

- CameraMaker Plug-In for 3D Studio MAX (CM\_MR.DLU file)
- Documentation (CM\_MR.HLP - help file)

It requires:

- Pentium 200 MHz CPU (for tools)
- 64 MB RAM (for tools)
- Pentium 100 MHz CPU (for playback)
- Windows 95
- 3D Studio MAX 1.2

## Installation and Authorizing

The CameraMaker package consists of two files: CM\_MR.DLU (program file) and CM\_MR.HLP (help file). These two files should be copied into the PLUGINS subdirectory of 3DSMAX, or to any other directory that is listed in the [Directories] section of the 3DSMAX\PLUGIN.INI file.

κ To make the CameraMaker help file visible to 3D Studio MAX, the following line should be added to the PLUGIN.INI file in the 3D Studio MAX directory:

In the [Help] section of the PLUGIN.INI file:

**CameraMaker Help=** CameraMaker \CM\_MR.HLP

If the CameraMaker has been installed in a location other than C:\3DSMAX\PLUGINS, the actual location should be specified in these lines (e.g. C:\Program Files\CMKR).

κ The CameraMaker plug-in requires authorizing. To authorize it:

1. Run 3D Studio MAX.
2. Go to the Utilities mode.
3. In the utilities list, in the *AnimaTek Tools* category, select the CameraMaker Modeling Utility.
4. The command panel of the utility should show 2 buttons — *Authorize* and *About*. Click the *Authorize* button.
5. The authorization dialog box will appear. It will display the ID number of the hardlock (the one that came with your 3D Studio MAX).
6. Call the company you purchased the CameraMaker from. Tell them your hardlock ID number.
7. You will be told the authorizing code. Write it down in a notebook or in your manual, along with your hardlock ID. You may use this code later. Enter this code in the proper field of the authorization dialog box. Click OK.
8. Switch to Modifier mode. Then Switch back to Utilities mode. This time, the CameraMaker utility should have full command panel. That means that the authorizing has been successful.

## Overview

CameraMaker is a tool for building complex systems of branching camera paths in the MAX scene.

Camera paths created by the CameraMaker are smooth and perfectly matched with each other at the branching points.

The tool provides means for camera speed control, including gravitation-based acceleration and deceleration.

And finally, it allows rendering the movies along these camera paths and to export all data necessary for building the interactive branched movie application.

The basis of this kind of applications is a set of pre-rendered movie fragments. These fragments are movies made by cameras that move in virtual 3D environment along a predefined set of trajectories, creating an illusion of flight or driving. As a movie comes to its end — camera comes to the end of its trajectory — this provides a choice of two or more continuing trajectories.

This choice can be up to the user. That is where the term *branched movie* comes from.

The branched movie — since it is pre-rendered — allows the display of a quality of graphics hardly available in real-time rendering technologies. At the same time it is interactive, since the user can select trajectories in real time. With reasonably planned structure of trajectories and bifurcation nodes, the illusion of interactivity can be achieved.

## CameraMaker Plug-In

CameraMaker plug-in is implemented as a single dynamic link library, CM\_MR.DLU. The full path to CM\_MR.DLU should be specified in the [Directories] section of PLUGIN.INI file in 3D Studio MAX root directory.

The procedural objects (Gate, Pass, Rail and VistaPoint) are listed in the *CameraMaker Objects* category in the Create panel of 3D Studio MAX. The utilities (CameraMaker Modeling, CameraMaker Rendering) are listed in the *AnimaTek Tools* category in the Utilities panel of 3D Studio MAX.

The cameras that are created for the Rails and VistaPoints are not procedural — they are regular 3D Studio MAX cameras. They can be created for all Rails and VistaPoints in the CameraMaker Modeling Utility, see [How the cameras are created](#).

## Main steps of working with CameraMaker

### 0. Configuring the project.

First, the κ **Main Project Folder** (directory) should be created. It will be the folder where all the data relevant to this project will be stored. Root directory of a disk cannot be the Main Project Folder. The Main Project folder should contain the following subfolders:

#### **.\MAX**

This folder should contain the scene (\*.max) file.

#### **.\MAPS**

This folder should contain all the texture bitmaps used by the scene, as well as the palette file (BMP) used for rendering movies in FLIC format. This folder must be included in the MAPS directories list of 3D Studio MAX.

#### **.\IMG**

This is the output folder for storing rendered image movies. This folder must be specified as the Image folder of 3D Studio MAX.

#### **.\TMP,**

Folder for temporary files



#### **.\CAM**

Folder for \*.CAM files that store the camera trajectories.

#### **.\C18**

Folder for temporary files

κ In this document we will refer to the Main Project Folder as **PROJDIR**.

Then, the Main Project Folder should be specified in the Settings Dialog Box. Run 3D Studio MAX, go to CameraMaker Modeling Utility and click the  (settings) button. The Settings Dialog Box will appear. The Main Project Folder should be entered in the top field of the dialog box. Use the  (browse) button to browse the directories list. The other settings — parameters for Gates, Passes, Rails etc. — can be specified either at this moment or later.

## **1. Creating the 3D scene.**

First, the 3D scene should be created in 3D Studio MAX 1.2 (or later).

Then, one can start preparing trajectories (paths) for cameras that will be used for rendering the movies.

## **2. Placing gates.**

Since, at the points of branching, the movies have to change smoothly, the cameras must be placed very accurately in the junctions of the trajectories. To provide this accuracy, objects called *gates* are placed at all points of junction. The gates specify the camera's position, roll and direction of view. Each trajectory starts in one gate and ends in another gate, hence in each gate the cameras (of all trajectories that meet in this gate) will have identical parameters. So, for creating camera trajectories, one should start with placing gates. Gates are implemented as procedural objects in the CameraMaker plug-in.

## **3. Creating rails.**

When the gates are ready, the trajectories connecting them can be built. Each trajectory must have a *rail* — a special purpose procedural object implemented in the CameraMaker plug-in — that stores all information about the trajectory, and can be used either just for previewing the trajectories, or as real rail in the movie. If the gates — start and end points of the rail — are not sufficient to specify its shape, the *passes* (another type of procedural objects implemented in the CameraMaker plug-in) can be placed along the trajectory. Actually, each rail is built along a spline curve, for which the gates define starting and ending points and directions, and passes can define control points and directions in the control points. The tension of the spline can also be adjusted in gates and passes.

## **4. Specifying camera speed.**

The next step is to specify the camera speed in the gates and passes. The CameraMaker plug-in allows calculation of camera speed using the gravitation approach.

## **5. Creating camera animation.**

When all gates, passes and rails are ready, the cameras can be automatically created and animated with just one mouse click by the CameraMaker plug-in.

## **6. Preparing data for rendering.**

At this step, the \*.CAM, \*.C18 files that store the cameras' trajectories and the topology list PATHLIST.TXT are created.

## 7. Rendering the image movies.

The image movies can be rendered in a sort of a batch mode by clicking a button in the CameraMaker plug-in dialog.

## Technical Requirements for CameraMaker

CameraMaker is a plug-in for 3D Studio MAX. It will work with MAX release 1.2 or later.

The following requirements should be followed while working with CameraMaker:

1. The right-handed coordinate system should be used. At the Top view in MAX, the X axis should point to the right, Y axis upwards, and Z towards the user.
2. The Time Display settings in MAX should be set to Frames. The animation range must start at Frame=0.
3. CameraMaker uses the metric system. It can be important for correct calculation of camera speed.
4. The node names starting with Gate, Pass, Rail, are reserved for special purpose procedural objects. User should not create other objects whose names have these prefixes, nor manually modify the names of such objects, unless in situations explicitly recommended in this document.
5. The camera names starting with CamR and CamV are reserved for cameras that are created by CameraMaker.
7. Although MAX allows duplicate node names, it is highly recommended that all nodes in the scene have unique names.

## Gate and Pass Objects

Gate objects, or gates, specify the start and the end of camera paths for each movie. Camera position, roll, pitch and yaw at the beginning and at the end of the path are unambiguously defined by start and end gates, respectively. When a movie ends, i.e. the camera path reaches its end, the *branching* can occur. *Branching* means that there are more than one branch (camera path) that start where the preceding path ends. The end gate of the path is also the start of the branches that follow it. Therefore, the position, roll, pitch and yaw of the camera will remain continuous from path to path.

The 3D representation (mesh) of Gate objects looks somewhat like a vehicle. Its front part is lower and more narrow than its rear part. A small spike can be seen on the top left side of the gate mesh to help distinguish the gate's left and right sides.

The position and orientation of the gate define the position and orientation of the camera.

The camera's eye is placed into the zero point of the gate's coordinate system, that is approximately in the center of the gate's rear wall.

The direction of camera view coincides with the gate's X axis, that is the direction from the gate's

rear to its front.

The roll of the camera equals the roll of the gate, within -180 to 180 degrees.

The pitch of the camera equals the pitch of the gate. When the gate is oriented horizontally (in the world XY plane), pitch = 0. Pitch can be within -89.9 to 89.9 degrees. *Strictly vertically oriented gates (pitch = 90 or -90) are forbidden.*


The yaw of the camera equals the yaw of the gate. When the gate is oriented along world X axis, yaw = 0, along Y axis — yaw = 90 degrees. Yaw can be within -180 to 180 degrees.


The size of the gate does not affect anything. User can select any display size for the gate mesh.

The name of the gate object must strictly follow the naming convention: it can look like:

Gate01 Gate02 .... Gate09 Gate10 Gate11 Gate99 Gate100 Gate999

There can be a maximum of 999 gates in the scene. The number of the gate can be seen in the part of its name that follows the *Gate* prefix. The *Gate* prefix must have the *G* in uppercase and the *ate* in lowercase. Leading zero must be used for gate numbers 1 to 9. There cannot be two gates with identical names (numbers) in the scene. The numbers 900 to 999 are reserved for the gates that define the VistaPoint objects.

A gate can be created by clicking the Gate button in the CameraMaker Objects category of 3D Studio MAX Create panel. After that, the gate can be positioned by clicking (and holding the mouse button) into a viewport, and rotated until the mouse button is released. The default size of the gate can be specified in the Settings dialog ( button ) of the CameraMaker Utility.

When the gate is about to be created, its position and the size can also be entered manually in the Gate Keyboard Entry dialog. Then the  button should be clicked to create a new gate with these parameters.

The position and orientation of the gate can be adjusted manually by using standard Move and Rotate command modes in MAX.

Once the gate is created, its parameters can be edited in the Gate Parameters dialog. The gate's parameters are:

*Speed* (km/h) — camera speed (at the moment when the camera is at the gate)

*Forced pitch* (degrees) — the pitch that the camera will have at the gate. When Forced Pitch = 0 (which is the most typical situation) the camera's pitch will equal the pitch of the gate node. Forced Pitch is defined *not* the same way as regular pitch, but rather by measuring the angle based on the vertical axis (world Z). Forced pitch can be 0 to 179 degrees.

*Tension Forward* and *Tension Backward* define the tension of the camera path splines that come to this gate from its front and rear part, respectively. The default value is 1. Tensions must be positive. High tensions ( greater than 8 or so) are not recommended.

*Display Size* (world length units) — defines the size of the gate mesh object. It does not affect the camera trajectory.

A gate can be also cloned (as Copy) from another gate, or created in CameraMaker Modeling

Utility. In these cases it is the user's responsibility to provide a correct and unique name for the new gate.

*Pass* objects are very similar to Gate objects. However, while the gates are used as the start and end control points for camera path splines, the passes are used as internal control points, if necessary. Each pass defines the position and orientation of the camera at a certain point of the path (in the same way as the gate does in the start or end point). The Pass objects must have the *Pass* prefix (also case sensitive) and must have unique names. Except for these differences, all that has been said for gates also works for passes.

The CameraMaker Modeling Utility offers several convenient functions for handling gates and passes. See the [CameraMaker Modeling Utility](#) section.

## Rail Objects

Rail objects are spline based procedural objects that have three functions. One is to visualize the camera paths at the modeling stage of the project. Another is to store all the spline data for the camera paths. The third function is to be rendered as real rails for the final movies. The rails are always present at the modeling stage. However, they can be hidden when the final movie is being rendered.

Each rail is defined by 2 gates, and, optionally, by up to 6 passes. The passes are not necessary. They can be used when the gates are not sufficient to define a sophisticated camera path.

Since all gates have unique names/numbers, one of the two gates that define a rail has a smaller number and the other has a greater number. The gate with the smaller number is called the *start gate* for a given rail, and the other gate is called the *end gate*. It is said that the rail goes from its start gate to its end gate.

The rail names must be unique. The structure of the rail's name is like this:

Rail001to002  
or  
Rail334to885



First comes the *Rail* prefix (case sensitive). Then the number of the start gate, with leading zero(s) added, if necessary, to make it 3-digit. Then the *to* separator, case sensitive. Then the number of the end gate, with leading zero(s) added, if necessary, to make it 3-digit.

In most cases, the rail is assigned a name automatically when created.

A valid rail can be created only when both start and end gates for this rail are already present in the scene. There are two ways to create a rail.

The first way to create a rail:

1. Go to MAX Create panel and click the Rail button in the CameraMaker Objects category.
2. Click in a viewport. Then right-click to stop the create mode. As a result, a dummy invisible rail node will be created. It will be assigned a name like Rail01, Rail02 etc.
3. Go to MAX Modify mode. A modifier panel for the created dummy rail will appear. If it does not, select the created dummy rail in Select via List dialog.

4. In the Rail Parameters dialog, Click the  (pick) button in the Start Gate group. Then, click at the start gate object in a viewport, or select it from the list by pressing the H key.
5. In the Rail Parameters dialog, Click the  (pick) button in the End Gate group. Then, click at the end gate object in a viewport, or select it from the list by pressing the H key.
6. Leave the Modify mode by switching to the Utility mode, and then go to Modify mode again.
7. The rail connecting the start and the end node will appear with the correct name.

The other way to create a rail is easier. It is described in the CameraMaker Modeling Utility section, in the Rail group of buttons.

The rollout dialog of the Rail object has the following parameters and buttons:

*Refresh selected* (checkbox) — should be checked to force the rail to be refreshed each time when its rollout dialog appears. A rail may need to be refreshed if its start or end gate or its passes have been modified.



— refresh the rail now.



— display the validity status of the rail and the number of frames in the camera path that goes along this rail, if any.



— display the About box.

*Start Gate* group:



(pick) button allows the picking of the start gate for the rail. When this button is clicked, user can pick the start gate in a viewport, or select it from the list by pressing the H key.

*Text field* to the right of the pick button displays the name of the start gate node, if one is defined.

*Forward* check box defines whether the rail is connected to the front or rear side of the start gate.


*Cap* check box defines whether the mesh of the rail object should be capped at the start gate (should be used only at the dead ends, to avoid holes that will appear if the rails are rendered in the final movie).

*Tension* defines the tension of the spline at the start gate. If tension is 0, the spline tension at the start gate will default to the forward or backward (depending on the status of the Forward check box) tension of the start gate.

*End Gate* group:

Similar to the Start group, only for the End node of the rail.

*Passes* group:

Rail can have up to 6 passes. The passes can be assigned by clicking one of  (pick)



buttons in the Passes group. The text field next to the each pick button displays the name of the corresponding pass, if assigned. The rail will start at the start node, then will come to the rear side of the first pass assigned, then to the rear side of the second pass, etc., and finally come to the end node. The order of passes is defined by the order of their name fields in the Passes group. The passes can be assigned in an arbitrary order. It should be noted that the passes should be used only for sophisticated rails (camera trajectories). Usually, for most rails, the passes are not necessary. The spline tension in each pass is defined by the tension parameters of the pass object.

*Radius* — radius of the rail, in world length units

*Sides* — number of sides the rail cylinder has (3 to 16).

*Segmentation* group:

Specifies how many segments the rail mesh should have. Depending on the radio button selected, the numeric value in this group stands for:

*Number* — total number of segments, distributed evenly along the rail

*Length* — distance between the segments, in world units

*Angle* — threshold angle, degrees. A new segment will be built whenever the direction of the rail axis (spline) deviates from the direction at the previous segment at the threshold angle value.

Default settings are *Angle* and 1.

*Tension* — default tension for rail spline, if the tension values in the gates are 0.

*No gravitation* check box — specifies whether cameras that go along this rail should be excluded from gravity-based speed adjustment.

*Forward Camera* check box — specifies whether the camera that goes from the start gate to the end gate should be created on this rail.

*Backward Camera* check box — specifies whether the camera that goes from the end gate to the start gate should be created on this rail.

*Forced Roll* group:

This group of parameters specifies the camera roll along this rail other than that defined by the roll of the gates/passes.

If the *On* check box is unchecked, the force roll parameters are ignored.

The following example explains the meaning of the Forced roll parameters. Let *Start* = 0.2, *End* = 0.9, *Peak in* = 0.5 and *Peak* = 45. In this case, the camera that goes along this rail, from its start gate to its end gate, will have the default roll (i.e. roll controlled by gates/passes only) from the beginning of the pass to 0.2 (20%) of the total path length. Starting from the 0.2 (20%) of the path length, and up to 0.5 (50%) of the path length the roll will gradually evolve to the value of 45 degrees. After that, up to 0.9 (90%) of the path length the roll will gradually evolve to its default value. And after the 0.9 (90%) till the end of the path, it will remain default.

*Warning:* *Start* values close to 0 and *End* values close to 1 can cause undesirable sudden jumps of the camera.

κ The rails are procedural objects that depend on the gates, passes, and rail parameters. Each time some of these factors change, the rail mesh should be rebuilt. When rebuilding, the rail mesh reinitializes its texturing and mapping coordinates. Therefore, if you intend to map rails with textures, it should be done only after all gates, passes and rail parameters are final. The *Rebuild Selected* option should be set to off for all rails to prevent rebuilding when a rail is selected.

Only one rail can connect two given nodes.

The positions of the start and end node should not coincide.

The CameraMaker Modeling Utility offers several convenient functions for handling rails. See the CameraMaker Modeling Utility section.

## VistaPoint Objects (VPs)

VistaPoint objects (VPs) are special purpose objects that help create cameras with rotational animation, allowing 360 degrees outlook.

Each VP is defined by 2 gates. These gates must have coincident position. One of the gates must be obtained from another by Clone/Copy and 90 degree rotation around the gate's own Z axis.

Since all gates have unique names/numbers, one of the two gates that define a VP has smaller number and the other has greater number. The gate with the smaller number is called the *start gate* for given VP, and the other gate is called the *end gate*. The numbers of VP gates should be 900 to 999.

The VP names must be unique. The structure of the VP's name is like this:

VP900to901

First comes the *VP* prefix (case sensitive). Then the number of the start gate. Then the *to* separator, case sensitive. Then the number of the end gate.

In most cases, the VP is assigned a name automatically when created.

A valid VP can be created only when both start and end gates for this VP are already present in the scene. There are two ways to create a VP.


The first way to create a VP:


1. Create a start node for the VP. Change its name so that its number is 900 or greater. For example, let it be Gate900.
2. Clone this gate as Copy. Name the clone Gate901.
3. Rotate the Gate901 90 degrees around the gate's Z axis. Do not Move the gate.

4. Go to MAX Create panel and click the VistaPoint button in the CameraMaker Objects category.

5. Click in a viewport. Then right-click to stop the create mode. As a result, a dummy invisible VP node will be created. It will be assigned a name like VP01, VP02 etc.

6. Go to MAX Modify mode. A modifier panel for the created dummy VP will appear. If it does not, select the created dummy VP in Select via List dialog.

4. In the VP Parameters dialog, Click the  (pick) button in the Start Gate group. Then, click at the start gate object in a viewport, or select it from the list by pressing the H key.

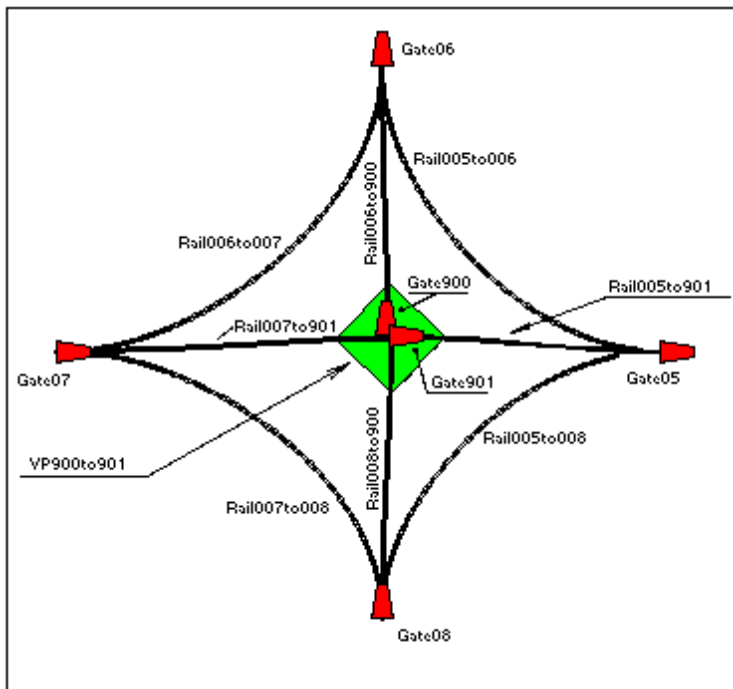
5. In the VP Parameters dialog, Click the  (pick) button in the End Gate group. Then, click at the end gate object in a viewport, or select it from the list by pressing the H key.

6. Leave the Modify mode by switching to the Utility mode, and then go to Modify mode again.

7. The VP with given start and end node will appear with the correct name.

The other way to create a VP is easier. It is described in the CameraMaker Modeling Utility section, in the VistaPoint group of buttons.

Let us consider an example of a VP:



In this picture, the gates (red) Gate900 and Gate901 define a VP (green). VP is not a renderable object. It is visualized by a box, approximately of the default gate size.

The gates that are connected by rails with the VP's gates (like Gate05, Gate06, Gate07 and Gate08 in the picture above) are called *gates adjacent to VP*. Each VP must have 4 adjacent nodes. Therefore, 4 rails come directly to the VP (in the picture above, these rails are

Rail006to900, Rail007to901, Rail005to901, Rail008to900).

The VP object is responsible for creating the cameras that rotate at the VP gates. In the example above, 8 cameras will be created:

CamV005to006 — the "eye" of this camera will be located in the Gate901. Its direction of view will be animated — from the starting position when the camera looks along the reverse direction of the Rail005to901, to the final position when the camera looks along the reverse direction of the rail Rail006to900.

CamV006to005 — animated the same way as CamV006to005, but with reverse order.

CamV006to007, CamV007to006, CamV008to007, CamV007to008, CamV008to005 CamV005to008 — animated in the same way. Each camera will have the same number of frames in animation, and will cover 90 degrees of 360. Combined together, the movies rendered for these cameras, will give the 360 degrees outlook. When any of these 90-degree-movies ends, it can be continued either by another 90-degree-movie, or by a movie along the rails that come out of the VP gates.

The rollout dialog of VP object has the following buttons and fields:

*Refresh selected* (checkbox),    — similar to those in Rail object dialog.

*Start Gate* and *End Gate* groups — similar to those of Rail objects (however some parameters are missing)


*Frames* stands for the number of frames in each 90-degree camera animation.


The CameraMaker Modeling Utility offers several convenient functions for handling VPs. See the [CameraMaker Modeling Utility](#) section.

## CameraMaker Modeling Utility



[How the cameras are created](#)  
[Tips and Tricks](#)


The command panel of the CameraMaker Modeling Utility has the following controls:

 button — calls the dialog with the default options for gates/passes, rails, VPs, cameras, etc. The settings are automatically saved in a separate file and loaded at the startup of 3D Studio MAX.


 button refreshes all rails and VPs and builds the cameras for all of them. The way cameras are created is explained below in this section.


 checks the consistency of the scene (validity of rails and VPs, naming conventions etc.)


 saves all gate/pass/rail/vistapoint information in an ASCII file. This file can be loaded back via  button. It can be used as an alternative way to backup the gate/pass/rail/vistapoint information.


 displays the About box.


The *Gate and Pass objects* group:

*κ* Keep in mind that when the gates/passes (or their parameters) are changed, the rails and cameras can become invalid or obsolete. Use the Refresh button  to refresh them.

 button — invokes a dialog box for creating a new gate or pass. A name for a new gate or pass should be specified in the *Name* field. The program will determine whether it will be a gate or a pass by the name specified. All other gate/pass parameters can be specified in this dialog box. The check boxes next to each input field can be ignored. If a gate or a pass is currently selected in the scene, this dialog will be filled with its parameters. It can be an easy way to create a gate or a pass: just select one that already exists, click this button, adjust the parameters (e.g. position coordinates), specify new name and click OK.


 button — invokes a dialog box to modify the parameters of all currently selected gates and passes. Only the values that are checked with the check boxes next to them will be changed for selected gates/passes. This is a handy way to change, for example, only the display size of all selected gates/passes. If the *by* check box is checked next to *Speed* field, the speed value for the selected gates/passes will be multiplied by (not assigned) the specified value.


 button allows the selection of gates/passes that belong to selected rails and VPs.

 button assigns the speed to selected gates/passes based on gravity. First, select the gates and passes for which you'd like to assign speed based on gravity. Click this button. Then click in a viewport on one of the selected gates or passes which you'd like to be the base for speed calculation. Then the dialog box will appear, where you have to specify the desired speed (km/h) in this base gate/pass, and the gravity (m/sec<sup>2</sup>). Then click OK. The speed in all selected gates/passes is based on gravity.


The *Rails and Vista Points* group:

The *Rails* subgroup:


 button — the easiest way to create a new rail. First, make sure that no nodes are selected in the scene. Then, holding the *Ctrl* key, click in the viewports the gates and passes for the new rail: first, the start gate, then the passes in the needed order (if any), and lastly, the end gate. Then click this button. A new rail will be created with the gates/passes specified, and the Modify panel for this rail will be displayed.  
*Warning:* when creating a new rail with this button, make sure that the Forward/Backward parameters are correct for its start and end gate.


 invokes a dialog box to modify the parameters of all currently selected rails. Only the values that are checked with the check boxes next to them will be changed for selected rails.


The *VPs* subgroup:

 button — the easiest way to create a new VistaPoint. First, make sure that no nodes are selected in the scene. Then, holding the *Ctrl* key, click in the viewports the gates for the new VP: first, the start gate, then the end gate. Then click this button. A new VP will be created with the gates, and the Modify panel for this VP

will be displayed.

 button — selects all rails and VPs that are affected by currently selected gates/passes.

 button — refreshes all selected rails and VPs.

 button — creates (or refreshes) the cameras for all selected rails and VPs. The way cameras are created is explained below in this section.

## How the Cameras are created

For each rail, one or two cameras are created, depending on the *Forward camera* and *Backward camera* settings of each rail. If the rail goes from Gate03 to Gate125, the rail name is Rail003to125, the forward camera CamR003to125 will follow the rail from Gate03 to Gate125, and the Backward camera will follow the rail from Gate125 to Gate03.

For each VistaPoint eight (8) cameras are created.

All cameras in the scene have the same FOV (field of view, measured in degrees), the same viewport width and height (in pixels) and aspect ratio. These parameters are defined in the CameraMaker Settings dialog.


The height of camera trajectory above the axis of the rail is defined by the *Above Rail Axis* parameter (in world length units) in the CameraMaker Settings dialog. It is a common parameter for all cameras, rails and VPs.

The length of animation for each camera, i.e. the number of frames in the movie, depends on the speed specified in the gates and passes of the rail. The *Frames Per Second* parameter (in the CameraMaker Settings dialog) defines how to convert time into frames. This parameter should be set to the expected frame rate for the movie playback in the final application. For each rail, the number of frames in the movie for its Forward and Backward cameras is the same.

Between gates and passes, camera speed can be affected by gravity — accelerated when moving downhill, decelerated when moving uphill. To prevent camera from complete stop, the *Minimal Speed* parameter (in the CameraMaker Settings dialog) is introduced. It defines the minimum allowed camera speed, in km/h. It is supposed that each camera has a small engine that turns on whenever the speed is about to fall below the *Minimal Speed* value and keeps the speed and least at the *Minimal Speed* level.




On the VistaPoints, the camera's animation has only rotational component. Number of frames for each of 90-degree-movies on the VP is defined by the *Frames* parameter of each given VP.

For all camera animations, the start frame in Frame = 0 in 3D Studio MAX.

If the cameras have been created for some rail, the number of frames in cameras animation for this rail can be seen by clicking the  button in the rail's parameters dialog box. Actually, it shows the number  $N$  of the last frame in the animation, and the total number of frames will be  $(N+1)$ , including frame=0.

## Tips and Tricks


Here is some advice for how to make your work with CameraMaker objects and Modeling Utility more efficient and error-free:


- κ 1. Before creating cameras, always check the consistency of the scene using the  button in the CameraMaker Utility.
2. Unless necessary to do otherwise, always use the *Refresh*  button in the top toolbar of the CameraMaker Modeling Utility to create cameras. The cameras will be created for all rails/VPs at once.
- κ 3. Never turn the Animate button on.
4. Create Gates, Passes, Rails and VPs using the tools of the CameraMaker Modeling Utility (described above) rather than using MAX *Create* mode.
5. When cameras are created, a movie can be rendered with this camera using the standard MAX procedure. The start frame of animation is 0 for all cameras. The end frame can be obtained by clicking the *Info*  button in the parameters dialog of the Rail or VP corresponding to this camera.
6. You can delete cameras at any time to make the scene less messy. Cameras can be easily rebuilt with one click (see 2) from the Gates, Passes and Rails and VPs.


## CameraMaker Rendering Utility


The CameraMaker Rendering Utility prepares the data that are necessary for image rendering and building the final database. It also performs image rendering in batch mode.


The command panel of the CameraMaker Rendering Utility has the following controls:

 button — call the dialog with the default options for gates/passes, rails, VPs, cameras, etc. The settings are automatically saved in a separate file and loaded at the startup of 3D Studio MAX.

 displays the About box.

 (*Prepare*) button exports the data that are necessary for image rendering and building the final database. For each camera it exports a \*.CAM file into the CAM subdirectory of the main project folder, and a \*.C18 file into the C18 subdirectory. Also, it creates the PATHLIST.TXT file in the main project folder.

 (*Render*) button starts the batch rendering of the movies specified in the PATHLIST.TXT. It uses the \*.CAM files exported by the *Prepare* command. Rendering can be started only after the PATHLIST.TXT and CAM/C18 files are prepared.

Before rendering via the  button, the following steps should be performed:

1. All non-renderable objects, including gates, passes and VPs should be hidden.
2. Save your scene as a .max file.

κ 3. In MAX menu, click *Rendering* and then *Render*.

4. In the Render Scene dialog:

Set *Time Output* to *Active Time Segment*;

Set *Output Size* to camera width, height and aspect ratio;

Set *Options* as needed;

In the *Render Output*, Set *Use Device*, *Net Render* and *Virtual Frame Buffer* to *OFF*. Set *Save File* to *ON*. Click *Files...* button. Specify the following output file:


PROJDIR\IMG\max.flc or PROJDIR\IMG\max.avi

*Note regarding the FLC files:* in MAX's output file dialog box, the correct setup (Setup button) should be done for the FLC file. The custom palette should be specified. The source file (BMP) for the palette should be located in the PROJDIR\MAPS. All flics must be rendered into the same 256 color palette. The first color of the palette must be black (rgb = 0 0 0).

Be sure to specify the correct directory for the output file — it should be always the IMG subdirectory of the Main Project Folder.

Click *Close*

5. Again, save your scene as a .max file. The rendering options will be saved with the .max file. This scene is ready for rendering.

Now, the rendering of all the movies for all the cameras can be launched by clicking the  button in the command panel of the CameraMaker Rendering Utility. When this button is clicked, a dialog box appears. In this dialog, the following check boxes can be set:

*Skip Existing Movies* — specifies whether the movies that already exist (in the IMG subfolder of the main project folder) should be skipped or re-rendered and overwritten.

*Hide Rail???to??? objects* — specifies whether the rails should be hidden before rendering.

When ready, click the *Render* button in the dialog. Rendering will begin.

The renderer processes the cameras in the same order as they are listed in the PATHLIST.TXT file (see above) that acts like list-to-render. Semicolon can be used to comment out the lines in this file, in order to exclude some cameras from the rendering list, whenever necessary. The C-style comments can also be used (/ \* and \*/), however these comments must not break the lines.

Large scenes with lot of cameras can take hours or days to render. The rendering should work as an exclusive task on the computer. It is necessary to close all applications except MAX before launching rendering. The screensavers, System Agents, reminders, software that works on-line, and other background tasks should be turned off — otherwise the rendering can be interrupted.

Rendering can be interrupted by the user at any time by clicking Cancel in the MAX Rendering info box.

The rendered images will be saved to the IMG subdirectory of the main project folder. Make sure there is enough space on the disk.



## PATHLIST.TXT (Topology list)

The PATHLIST.TXT file is created by the Prepare  command of the CameraMaker Renderer Utility. This file is located in the Main Project Folder.

The PATHLIST.TXT is used as the list of files to render by CameraMaker Renderer Utility. It can be also used as the topology descriptor of the camera paths system.

Description of each movie (path) takes one line in the PATHLIST.TXT. For each movie, the description contains the number of the movie (in the list), its name, number of last frame, and the information about the movies that may follow after this one during the interactive movie playback.

The semicolon in the PATHLIST.TXT file comments out the line up to the line break. C style comments /\* \*/ are also allowed, but they should not break the lines. Nested comments are not supported. Each line describing a movie can be either fully commented, or fully uncommented.

### Syntax of the PATHLIST.TXT

The number in the first line of the PATHLIST.TXT is the total number of movies in this file.

Each movie is described by one line, for example

```
11 004r003 40 -005r004 +003r008 N 003r007 003r002 003r008 3 33 003r007 34
003r002 33 003r008
```

Different groups of parameters are shown in different colors. Here is the explanation of the parameters, group by group:

11 004r003 40

11 is the number of the movie in this list

004r003 is the name of the movie (the common name for movie files).

40 is the number of the last frame in the movie. Since all movies start at frame 0, the total number of frames in the movie is 41.

-005r004 +003r008

These two parameters are needed for database packing. They should not be changed by user unless directly recommended in other sections of this document.

N

Type of movie. For most of the movies, the type is N (normal). For VistaPoint rotational movies the type is V. For the Exit movie it is X, for Entry E, for Escape S.

003r007 003r002 003r008

Three movies specifying three possible branches that can start playing after this movie is over. First comes the 'left turn movie' — one that we switch to when the left arrow is pressed, the second is the 'forward movie' (up arrow key), and the third is the 'right turn movie' (right arrow key). If there are only two branches, one of them should replace the forward movie. If there is only one branch, its name is repeated three times.

These parameters can be corrected manually by the user. For example, some camera paths can diverge from a gate in such a way that there is no way to determine correctly which is left and which is right. The program that saves the PATHLIST.TXT file tries to do it, but in some cases user correction may be required. If, when playing back the

branched movie, you see an inadequate reaction to left/up/right arrow keys at some junctions, it can help to switch the places of some of these parameters.

Using left/up/right arrow keys for branch selection is only one of many possible ways of control. The API allows the assigning of branches to other keys or events.

3

The number of branches that can be switched to based on probability coefficients (see below) when no user input is received.

33 003r007 34 003r002 33 003r008

These three pairs of numbers define the probability coefficients for the branches that can start after the movie is over. First comes the probability for the first branch, in percents, then the name of the first branch, etc. The sum of probabilities must be 100. If there are only two branches, this line can look like 50 003r007 50 003r002. If there is only one branch, it can look like 100 003r007.

For the VistaPoint movies, the syntax is slightly different and more complex. However, the descriptors for the VistaPoint movies are not subject to correction by the user.

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