Instructions for Vehicles with Physics-Engine

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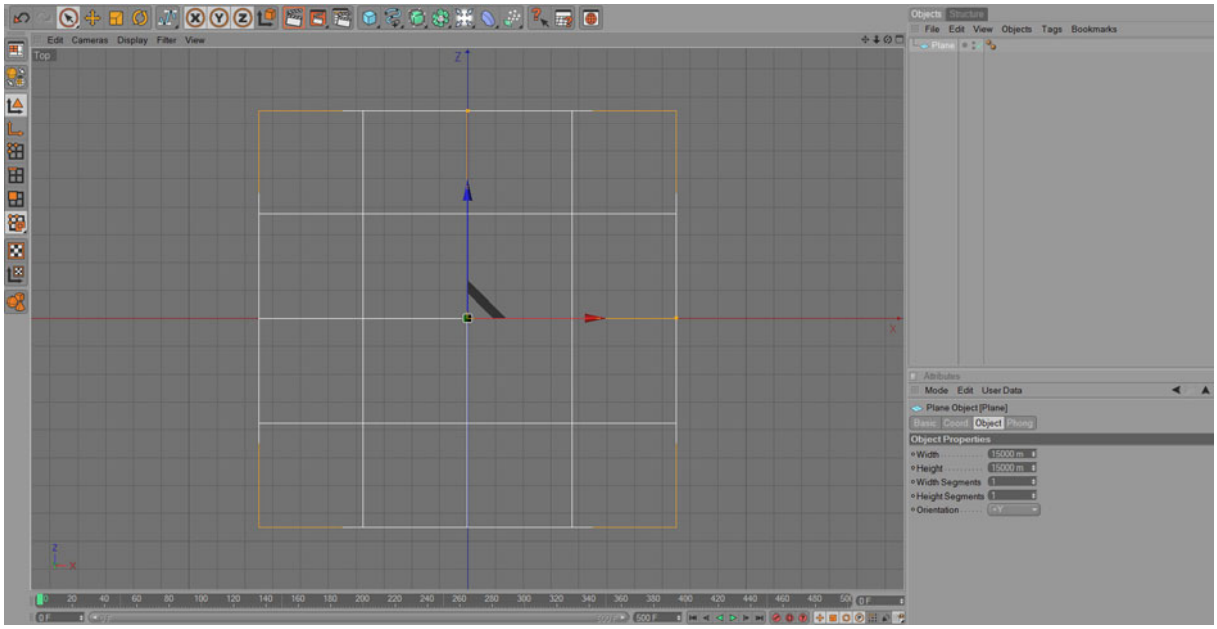
Through the following instructions and sample-screenshots you will learn how to fill 3D-scenes with animated traffic by using vehicles from DOSCH DESIGN with built-in physics engine. Process and settings will be shown step-by-step for easy replication and study of this important concept.

1. Creating the Sub-Structure

Start Cinema 4D and -using top-view- create a plane containing various basic objects. Then, set the width and depth attributes of the plane to 15000 units each, plus their respective segment number to 1, since first we only want to let the vehicle drive along a level surface. This will allow us to focus on the basic steps of the animation process. Next, please press the 'c'-key in order to convert the plane into a polygon-object. This is important since the surface-wheel contact only works with a polygon sub-structure.



2. Creating the Track-Spline

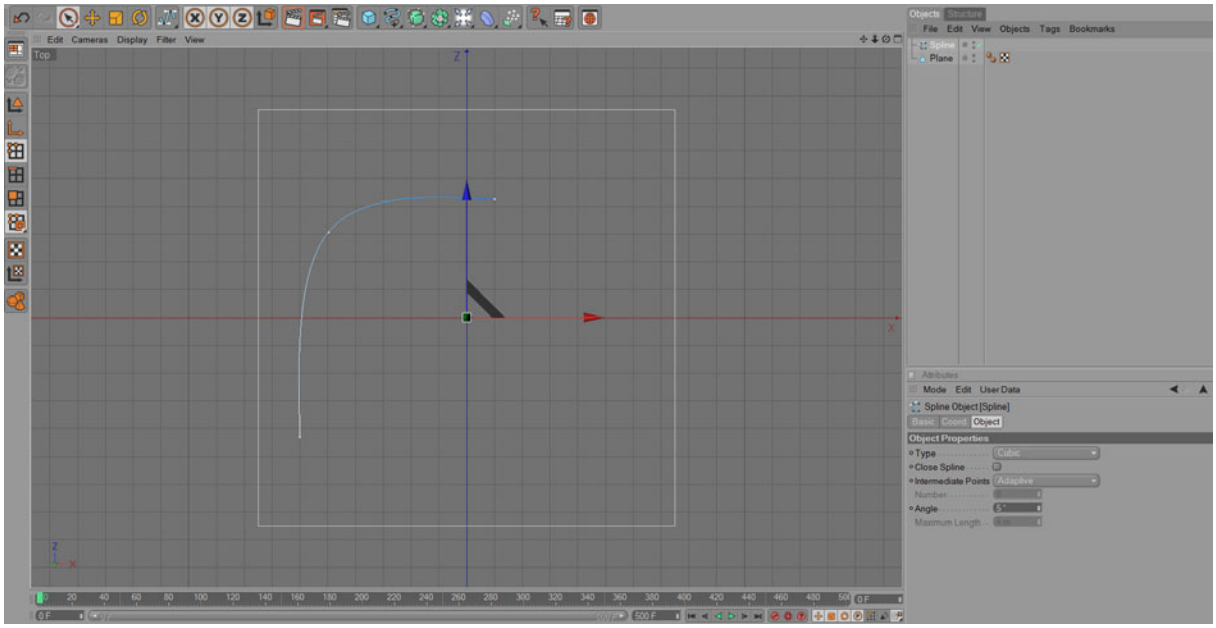
Next we create the spline which will represent our driving course (track). Two types of splines can be recommended for realistic results:

1. Bézier-Spline: this spline variety allows the recreation of very exact curve characteristics, but does require some skill when using the tangent tool. However, this process will also be elaborated on further down in these instructions.

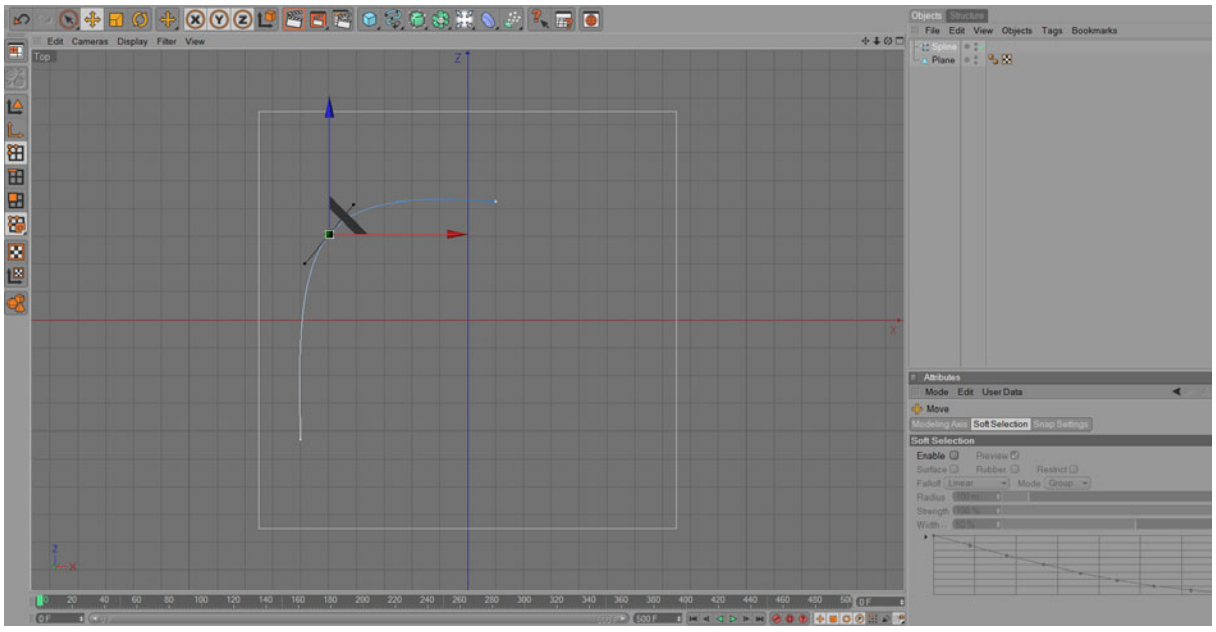
2. B-Spline: mathematical calculations are at the core of this spline, and they result in very soft curve features. Although curve shapes can't be controlled quite as well as with the Bézier-spline, the upside here are speedy implementation and corrections. Ideal applications for the B-spline are depictions of off-road tracks through wilderness or desert territory for instance, or other settings where precise curve attributes are not particularly important.

In our example we are using a Bézier-spline in order to be able to discuss and exemplify the use of the very useful tangent control tool.

Definitely remain in the top-view mode in order to create the spline-points on the XZ-plane (floor). Next please choose the spline-creation for cubic splines, by successively clicking the points as shown in the following depiction.



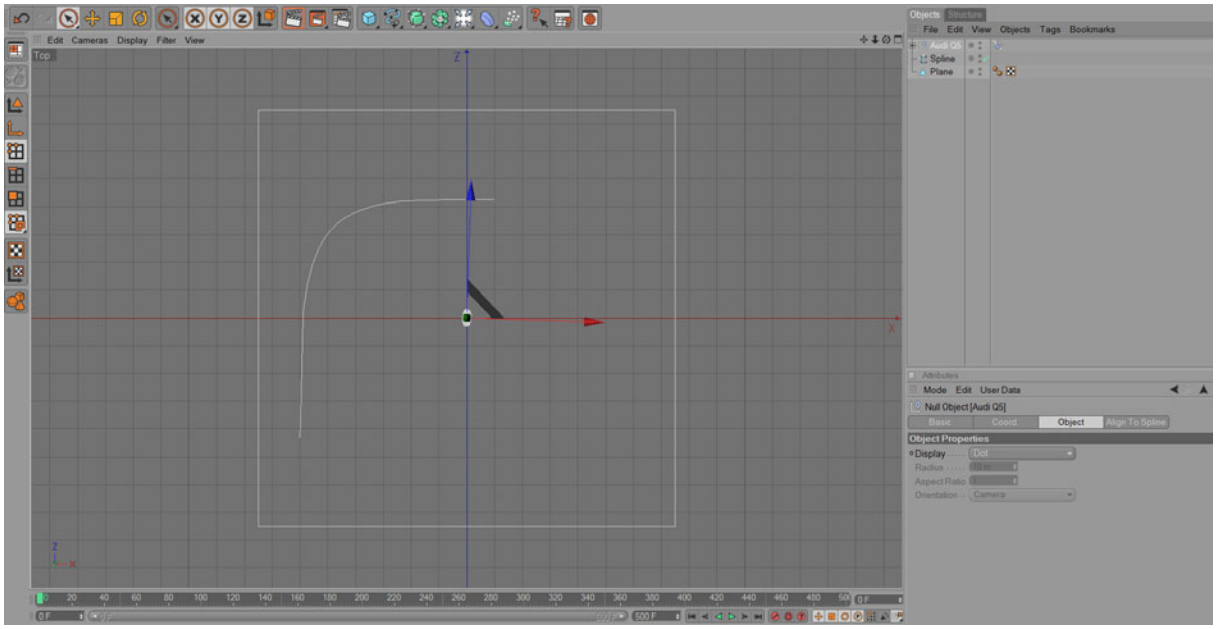
Now select the newly created spline in the object-manager, and switch the object attributes to Bézier-type. Obviously the spline could also have been created as Bézier-spline right away, however this would require some additional practice since creation of every point requires proper alignment of the respective tangent … a potentially tricky process. The cubic spline is already providing the basic direction and can then easily be switched to Bézier-type. This automatically repositions the tangents precisely enough for acceptable results. Lastly please set the control-points to “natural”.
Having done that, the shape of the spline can easily be adjusted by using the Move-function.



Please select the middle point, which should produce two black „grabber"-features at the point. These can be moved only through the Move-function, but not through the Live-selection. Simply click on a "grabber", hold the left mouse-key pressed and move the mouse in various directions. Such simple movements will control the length of the tangent, as well as its orientation. Extending the tangent in this example will result in a softer and rounder curve-shape. However, the tangents of surrounding points will also have an impact on the curve's characteristics. That's why some practice and experimentation is definitely necessary until the "perfect" curve can be accomplished. A specific half of any tangent can be modified with a pressed Shift-key, but we advise against that since this will result in visible "jumps" (jerky movements) in the vehicle's positioning when such points are passed over. The smoother a curve's shape is defined the more realistically will the vehicle move around it during animation.

3. Loading of the Vehicle

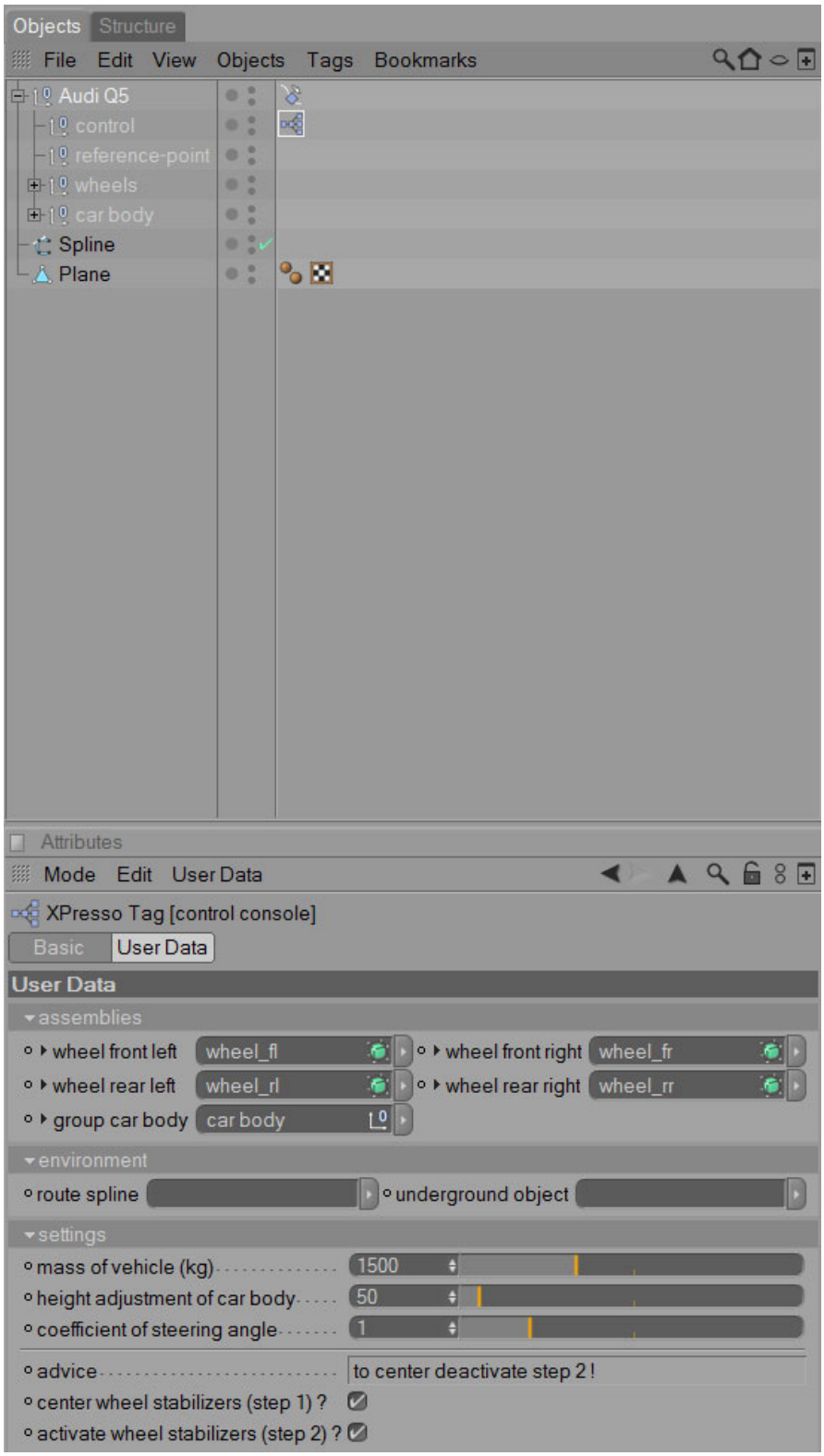
Now the vehicle is added to the scene. Under the File -> Load ... please choose the Cinema 4D-file of your desired DOSCH DESIGN-vehicle. Without delay it will appear at the zero-point of the World Coordinate System.



If the vehicle in your scene appears too large or too small then we recommend to adjust the scale of the overall scene and not that of the vehicle, since the latter could distort the calibration-points for the correct functioning of the vehicle. The risk for that happening depends on how much the vehicle is being scaled up or down. In any case – it's safer to re-scale the scene instead.

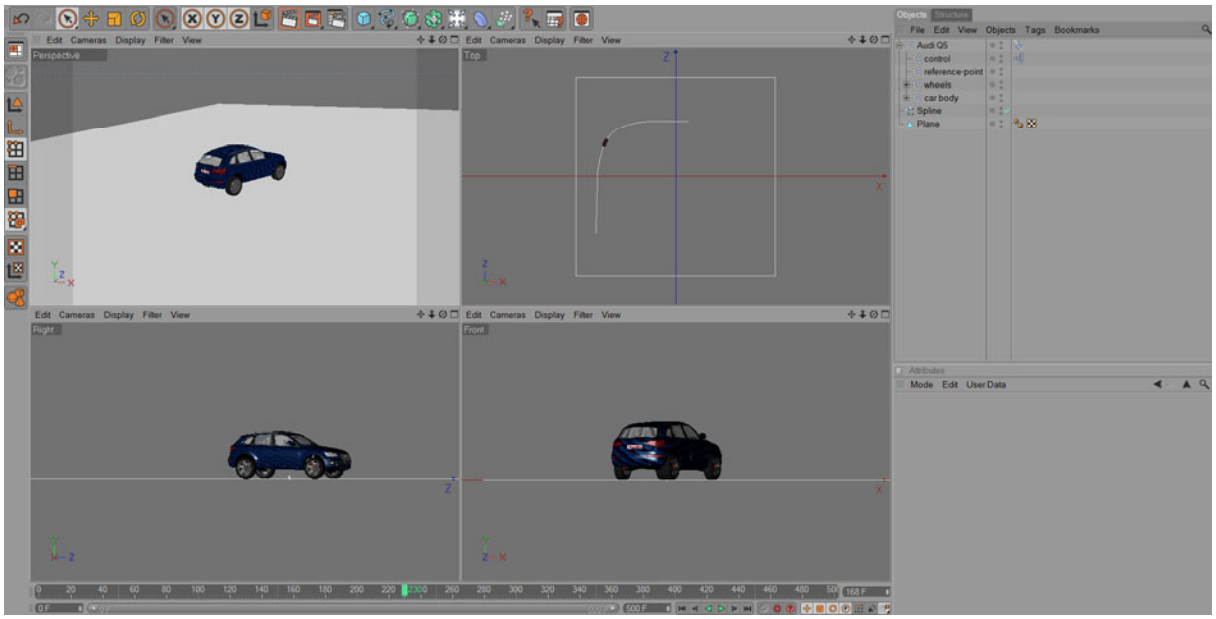
4. Putting the Vehicle onto the Spline, and Activation of the Underground Object.

In order to put ones vehicle onto the created spline the vehicle's hierarchy needs to be opened in the Object-manager by clicking on the preceding plus-sign. Amongst others this will make the Zero-objects "control" and "reference-point" visible. Under no circumstances must they be deleted, or their position in the hierarchy be changed. Naturally, the same rule applies for the "wheels" and the "car body". Only the uppermost Zero-object of a 3D-model (in this case the complete "Audi Q5") should ever be moved.
The Object-manager features an XPresso-tag behind the Zero-object "control". Please click on it once and various entry-fields pop up in the attribute field:



Two of the fields are empty: “route spline” for the driving track, and “underground object” for the underground object. Now please pull the spline created by you from the Object-manager into the field “route spline”, as well as the plane into the field “underground object”. Immediately the vehicle „jumps“ to the starting-point of the spline, and the wheels automatically touch the underground correctly. If the car body happens to “float” too high or too low above the ground its elevation can be corrected with the slider “height adjustment of car body”. If the front-wheels’ turning-angle is too strong or maybe also too insufficient for curve shape at hand, that too can be corrected quite easily – in this case with the “coefficient of steering angle”- slider. The other fields are irrelevant and should

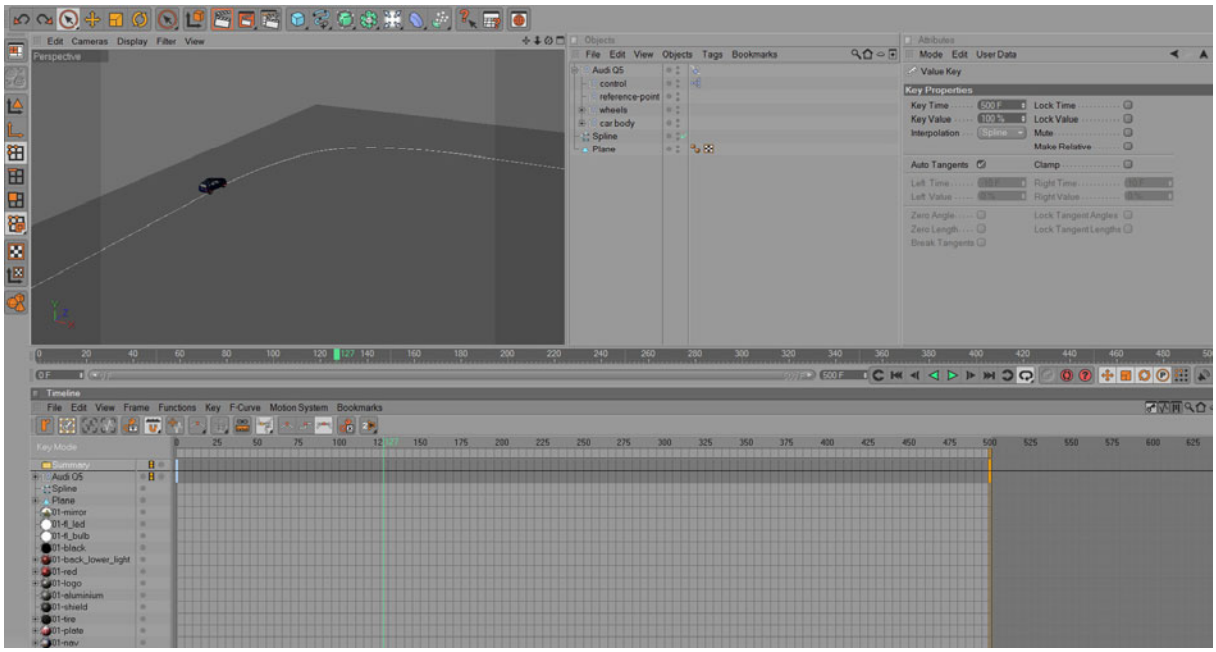
remain unchanged. If you click on the Play-button, the vehicle should slowly start moving from the starting-point, then accelerate gradually, and –at the end- decelerate until coming to a stop. This concludes your first driving animation.



5. Adjusting the Speed

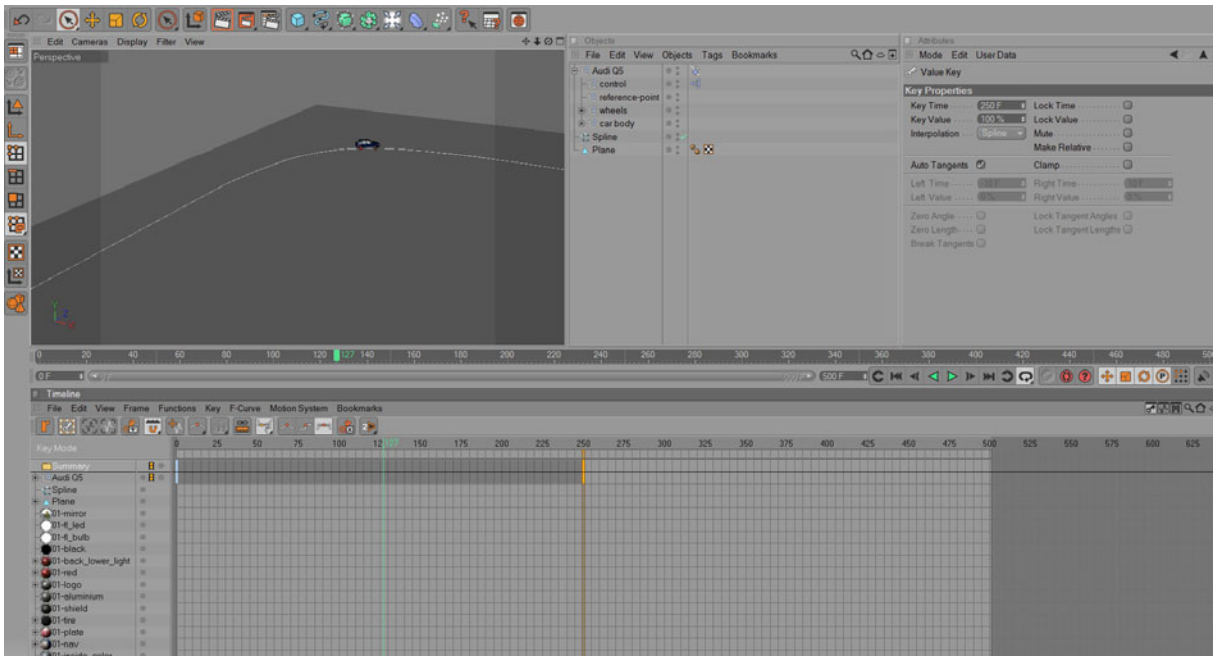
The standard driving-animation is set to a time of 500 images. If you want to change anything about the animation please follow the descriptions below.

For fine-tuning simply switch to the standard-layout „Animation“. This will display a detailed time-scale with which the animation can be modified in order to suit your preferences.



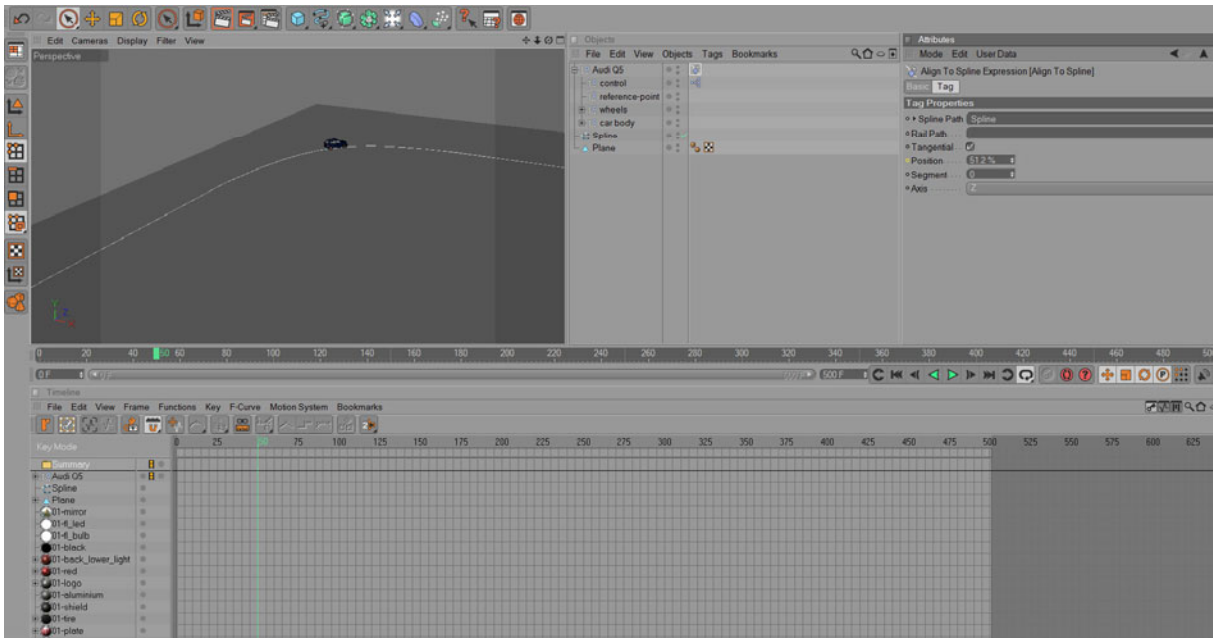
Please reduce the viewing area so that all keyframes from Key 0 to 500 can be seen. While holding down the left mouse-key please click Key 500 on the full track and pull it to Key 250 for instance.

This will result in playing this very animation in 250 frames instead of the previous 500 frames, which translates into doubling of the driving-sequence's speed.

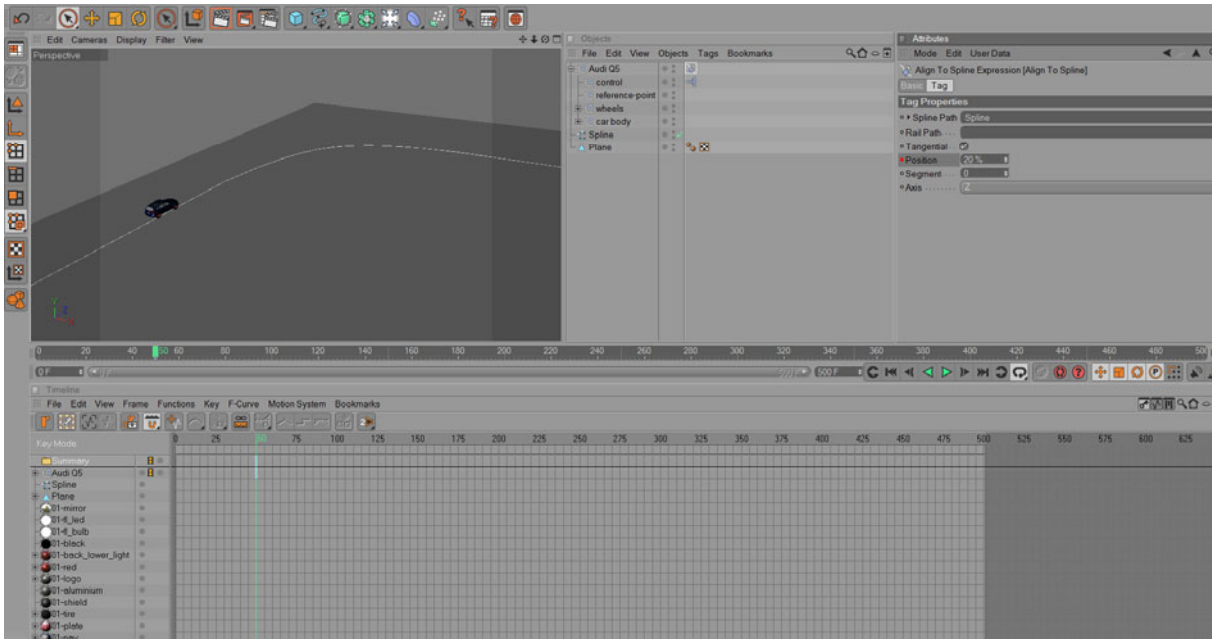


6. Animation with individual Start, Stop and Reverse Driving

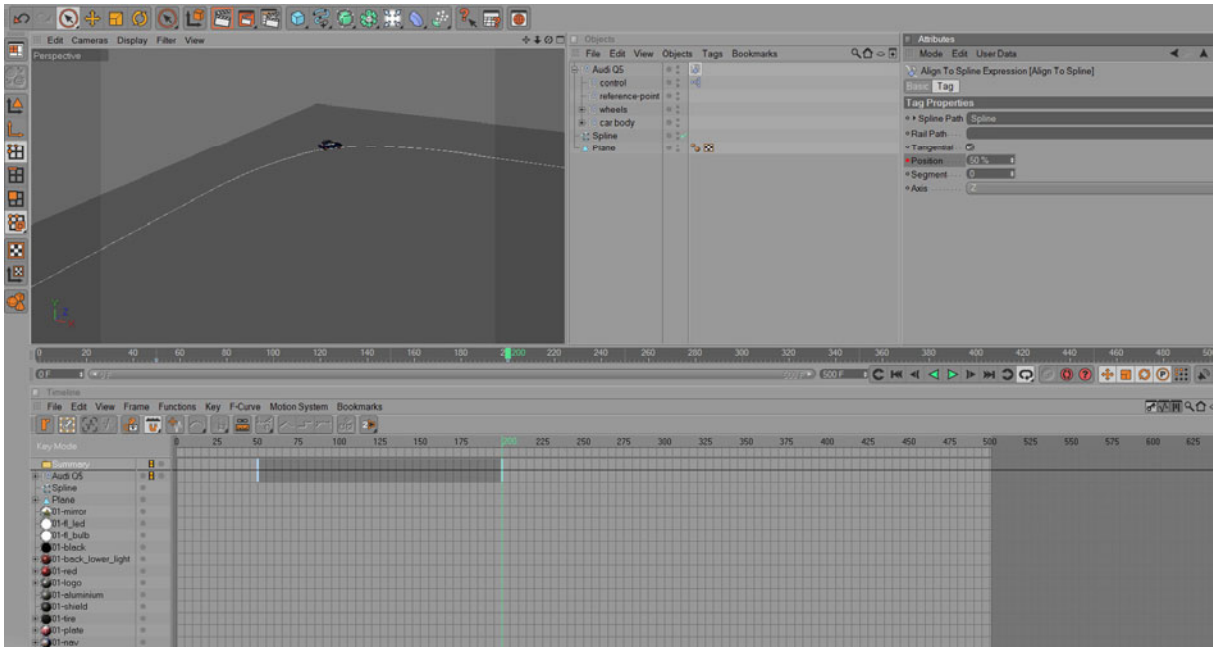
In order for the vehicle to perform specific start and stop maneuvers there is another way of achieving that. Simply delete all of the vehicle's keyframes in the "Animation" layout. Let's say the car is supposed to start moving at Key 50 for instance, and stop again at Key 200 – thereby driving only a certain section of the track.
For this you pull the green time-marker to frame 50 and click on the "Align with Spline"-tag behind the top-level Zero-group of the vehicle in the Object-manager. In the Attribute-manager you will then see the following image:



The setting interesting to us is the „Position“-feature. It provides the current frame-position (frame-#) of the vehicle on the spline. Since the time-selector is already set to Frame 50 we can readily continue from that position. If –for instance- we want to let the vehicle start at 20% of the track-distance, then we enter that value at “Position”. Once that is done please hold down the Ctrl-key and simultaneously click (left mouse-key) on the small circle in front of the word “Position” in the Attribute-manager. This will fill the circle with red and on the vehicle’s animation track appears a marked keyframe at Frame 50. Frames can be deleted by holding down the Shift-key+left Mouse-key. This concludes the setup for the vehicle’s starting position.



Now the vehicle is supposed to drive exactly 30% of the spline – until Frame 200, and then stop. In order to accomplish that we simply slide the time-bar to Frame 200, change the “Position”-value in the Attribute-manager to 50%, and –once again- hold down Ctrl-key + left mouse-key click with cursor on the small circle for “Position”. This way we have established the end-position. The vehicle’s animation track (grid) should now show a grey bar extending from Frame 50 through Frame 200.

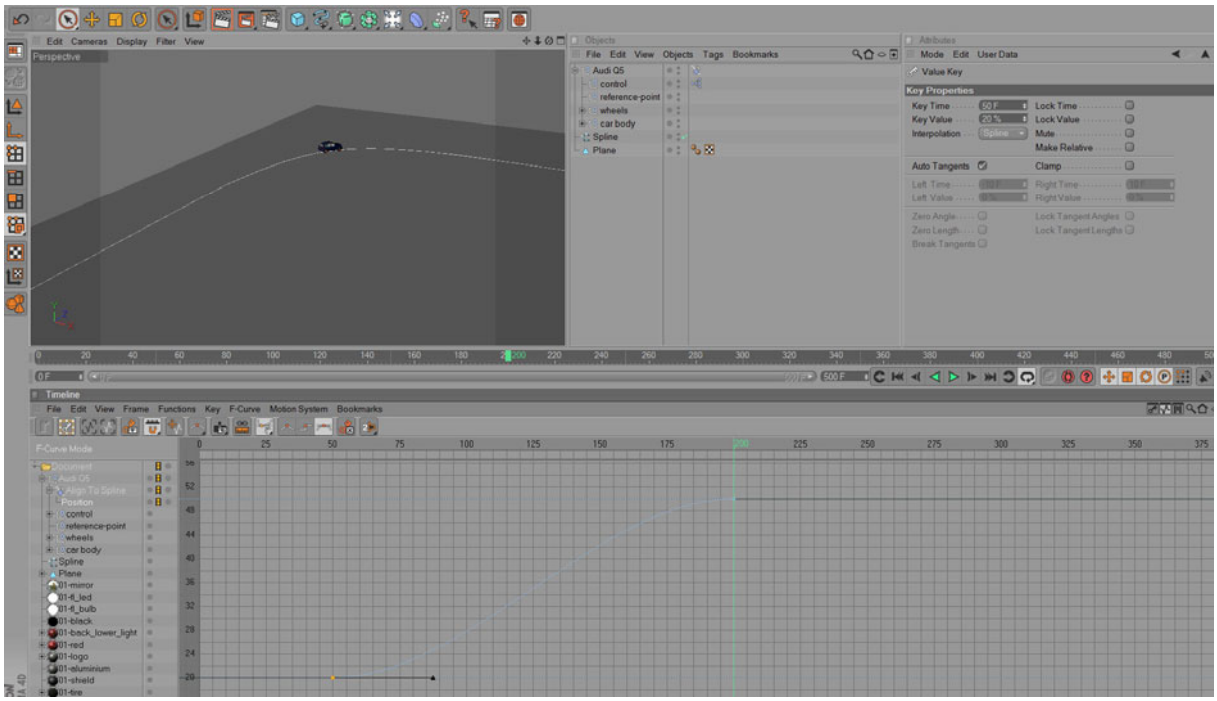


When starting the animation the vehicle will begin driving at frame 50 (Position 20) and stop at frame 200 (Position 50).

Following the same basic process the vehicle can be animated for reverse driving. In order to do so, a higher Position value is entered as starting-point (earlier/lower frame-#), followed by a lower Position value as the end-point (later/higher frame-#).

7. Calibration of Start and Stop-Animations

For some situations the vehicle is supposed to accelerate more slowly, or to come to a more gradual stop. This can also be accomplished, and for this demonstration we'll revisit the scene developed in chapter 6 above. The goal is now to let the car accelerate in a more measured way.
First let's click on the plus-sign in front of the vehicle-name in the „Animation"-layout. This will open a new hierarchy-level with a set of options, one of which is "Align with Spline". Now click on the latter's plus-sign and the "Position"-feature appears. A click on the small triangle-button in front of this option and then on the word "Position" itself will result in display of the curve-shape for the Position-animation. The grid of the animation-track will now show two shifted black lines (at Position 20 & 50 respectively) which are "connected" by a blue curve between Frames 50 and 200. Beginning and end of the curve-section are each indicated with a blue dot. In order to depict the curve at a larger scale please click on the small icon with the frequency-curve (near the right margin, just above the grid-system, next to the key-symbol). With these two icons (Frequency-curve and Key) the display can easily be switched back and forth. In order to achieve optimal curve-size the displayed section can be enlarged by using the icon on the right.
At this point please click on the blue dot at Frame 50, which indicates the beginning of the curve.



As you can see above the blue dot turns orange, and a black line with a small black triangle at its end appears. Manipulating this triangle will adjust the shape of the curve and thereby the animation.

Let's look at the curve in a bit more detail:
The animation starts at frame 50. Initially the curve ascends slowly but then becomes steeper and levels off as it approaches frame 200. And exactly that is translated into the vehicle's driving. It starts off slowly, then accelerates and ultimately slows down as it approaches the stop at the end. Since we

want to let the vehicle start even slower we need to extend the flat ascend at the beginning of the blue curve. In order to accomplish this please pull the small, black triangle over to the right (about to frame 125) with the left mouse-key pressed. Please make sure that the black control-line remains horizontal. When starting the animation it is now obvious that the vehicle is starting more slowly, then accelerates more quickly, and eventually is coming to a stop again. The quicker acceleration in the middle-section is a result of the fact that –by increasing the frame-count needed for starting and initial acceleration- we have reduced the available frame-number for the main acceleration. That acceleration is therefore condensed into a shorter timeframe and becomes more dynamic.

By playing around a bit with this concept, and experimenting with how certain parameter changes impact the visual animation, you will quickly develop a good feeling for animations created this way.

8. Unintended forward/backward Motion of the Vehicle during Stationary Phase

If the car in the animation performs unexplainable forward or backward motions, this could be caused by the automatic interpolation of the incremental values of two points through Cinema 4D. If this does happen please examine the curve's shape for the "Position"-feature while the animation is running. Mostly this error occurs when the vehicle is stopped after a driving sequence, and then the same position is set once again a few frames later, only to let the vehicle start driving again. The shape of the curve should be linear during a stationary phase. If that is not the case please click on the dot at the beginning of the stationary phase and choose setting "Linear" at Interpolation-feature in the Attribute-manager. This will result in a linear shape of the curve, and a vehicle which is standing perfectly still until the next controlled animation.