SPLINE MODELING OF THREE-DIMENSIONAL OBJECTS

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Spline modeling this method uses splines (flexible pattern, flexible plasma rail - strip of metal) three-dimensional curves. Splines are created by three points, splines also use spline primitives: Line (Line), arc (Arc), Circle (Circle), Ellipse (Ellipse), polygon (NGon), Section (Section), ring (Donut), spiral (Helix), spline text (Text) and others [1].

Spline primitives are not outlined at the visualization stage and are used as secondary objects to create more complex three-dimensional objects. Also, any spline primitive can be an independent three-dimensional object in the scene [2]. These examples have flexible settings, of course, there are more complex spline primitives that can be considered in other programs. Spline modeling is quite accurate and when scaling, the quality of a three-dimensional object does not change. Let's consider separate branches of splines.

An inhomogeneous rational B-spline is used in computer graphics as a mathematical form for the regeneration and representation of curves and surfaces.

Bezier curves are types of curves. A simple application of Bezier curves in computer graphics for modeling smooth lines was found. Quadratic and cubic Bezier curves of the second and third degree are of great importance in computer modeling. Curves of the highest degree are rarely used, since they spend most of the computer's work on themselves.

Polygonal modeling is currently one of the most popular types of modeling. A polygon is simply an array that describes a three-dimensional object. If three or more points are defined as vertices and connected by edges, the space filled between the edges is called faces, they form a polygon.

Thus, absolutely any object can be modeled, the disadvantage of this method is that everything is modeled by planes and when adding a large plane, you will have to add a lot of polygons so that the model does not have a faceted appearance, even though a large number of polygons will not be visible. For computer games, the model should consist of triangles, but preferences in the modeling process are still given to quadrilaterals, but when exporting to the game engine, everything falls into place.

In the blender program, you can also increase the number of polygons, but more detail does not always make much sense, since performance decreases. The originality of the model and perfectly smooth surfaces, favors great detail and a lot of polygons contributes to a similar product. The problem of this product will be a set of points that appear with a large number of polygons, thereby the processor will have to process a large amount of data. Solely for this reason, there is a conclusion that greater detail sometimes raises the question whether it makes sense or you can do with less realism. There are similar terms as high poly - a three-dimensional model with a high number of polygons and low poly - a three-dimensional model with a small number of polygons.

At the same time, do not forget about the advantage of the large detail of the model. When using large detail, even the ball becomes smoother, but if the number of segments is reduced, then by

as a result, we get a figure that little resembled a ball. With great detail, you can implement a lot of small details that may not be noticeable on the result as a whole, but when the camera approaches, it will be

visible and this will add more realism to the model. Naturally, low-poly models are used in computer games, since they have a sufficient number of polygons for visual perception of the resulting object.

As a result of the work done in blender, we get a mathematical model that needs to be given a certain color, a texture is used for this. In the process of modeling an object, you can set various properties of the object, because the model is only a shell. Materials are given realism to the object with the help of various effects.

Texturing is one of the important stages in the realism of the model, because when creating it, all our models differ from each other only in shape [3]. However, this is not enough, so the models are painted accordingly. Texture mapping is a time-consuming activity that has its advantages, such as great opportunities for creativity (grass can be not just green, but, for example, green with a flower).

To apply a texture, a scan is initially done or, in another way, a UV transformation is the ratio between the coordinates (X, Y, Z) on a three-dimensional object and the coordinates U, V on the texture. The coordinates U, V have a value of 0 to 1. The UV transformation is implemented both manually and automatically, the blender program has a deployment algorithm (Fig. 1.).

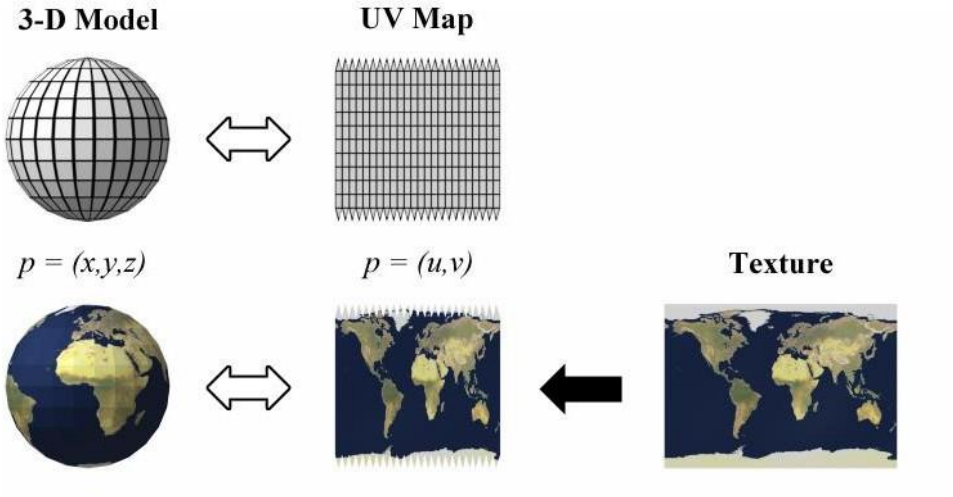

Fig. 1. Superimposing a two-dimensional texture on a three-dimensional object

The texture is a bitmap image superimposed on the surface of a polygonal model to give it color, coloring, or relief illusion; in other words, a two-dimensional image is superimposed on a three-dimensional model. The use of texture replaces the resource-intensive details of the model, such as scars on the skin and other small objects on other surfaces. Texels (pixel texture per minimum unit texture of a three-dimensional object) determine the quality of the textured surface. After all, since the texture is a two-dimensional image, its dimensions are of sufficient importance when superimposed on a three-dimensional object

In the process of modeling an object, you can set various properties of the object, because, in our opinion, the model is only a shell. Materials are given realism to the object with the help of various effects, including: bump map; relief map (displacement); normal map (normal map); transparency map (alpha); glare map (specular); color.

It is with the properties of materials that the object receives reflection, transparency and other properties with only one texture, it is impossible to get the final result.

There are quite a few light sources in the blender program, each for its own purposes and with unique properties that allow you to use this consecration in the same way as any object that can be easily moved and directed. Naturally, one of the greatest advantages in rendering gives us such an addition of glare and greater realism is mainly the shadow, which half determines good lighting. This is the only reason why it causes great difficulties, with a strong consecration of the three-dimensional model and with the wrong placement of light,

there can be no question of realism. The camera in blender is your point of observation of the scene, which can be fully customized, it is also the highest point of observation of the scene. The camera can be controlled and adjusted in the same way as any object. When rendering, you can use several types of displaying objects in the scene: Perspective, Orthographic, Panoramic.

Rigging is a process when a character is being prepared for animation, including placement in a three-dimensional rig model (from the English Rig – snap-in) [4]. Skeletal animation is when a skeleton is added to a character, it is not only about a person, a three-dimensional model has a hierarchical relationship (rig/ skeleton). Thus, the animation is carried out. Skeletal animation, for which rigging is carried out, is useful because it allows you to animate everything into the flesh before eye movement with a small number of bones. Due to the fact that the bones are hierarchically dependent, they are all connected to each other and, when moving, allows you to animate all subsequent bones associated with the one whose movement was involved, the bones also do not have to be hierarchically or whatever they are interconnected. The skinning process is directly related to rigging (from the English skin – skin) the connection between the surface areas. This process has its drawbacks.

The skeleton is suitable for both humans and any "bipedal creature", as it can be simplified to any state. It is worth starting from it when creating subsequent bones, their location should be combined so that there are no fractures. Naturally, the character does not need ribs, there is no sense in them and most likely the back will lose all its flexibility. Of course, a large number of bones will have to be made for brushes, that's where the character should have more realism. All proportions must be observed in order for the hand to bend like a real one and have a greater similarity with reality, Fig.2.

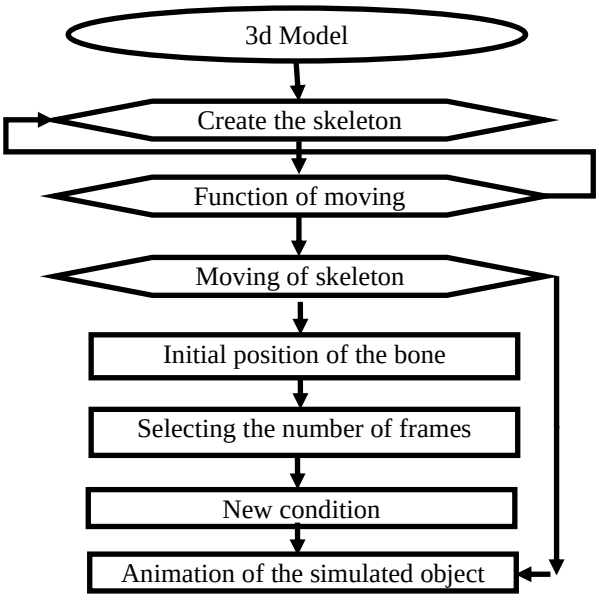

Fig. 2 Block diagram of the 3D model animation process

Animation is one of the fastest ways to display a chain of images with special movements. Animation is an important element of cinematography, since today it is difficult to imagine films without computer animation [5].

In 3D graphics, the resulting model is added to the price of other objects, the next step is to add a camera and light, and only after that you can get the finished image. Thus, visualization takes place, which is one of the important aspects of computer graphics in other words, rendering or rendering of the process, implemented using computer graphics and 3D models. Visualization is necessary to form the final image.

To summarize, the steps for modeling and animating the model were described. The modeling process consists of the following steps: concept development, modeling and texturing. The animation process, in turn, consists of steps: creating a skeleton, creating animation by moving bones. In this way, the designed technologies allow you to effectively create three-dimensional models and animate them.

The process of creating a cartoon is divided into three parts, so to speak, three different magical components that you have to go through to transform from a doll into a butterfly: pre-production (pre-production), production (production), post-production (post-production).

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