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Mapping in a 3D software environment

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Abstract

Object modelling in virtual environment is one of the most important tasks. It plays an essential role in achieving the most realistic output, or similarity of a scanned object. There are many software solutions available on the market a user can choose from, such as an intuitive ribbon interface or a mapping option. These options are very important because they can influence the process of mapping an object and have an impact on time it takes to map the object. Not every software solution can map objects without difficulties. It is essential that the functions of specific software solutions provide sufficient options, for modifying the process of mapping and texturing as well. In case there are enough options, then it is only a matter of time and of how fast the final effect is reached.

Keywords: Mapping, projection, digitizing

Introduction

In the current digital age, we can find various visual materials from photographs to films capturing realities and individual moments in lives of humans and animals. On the other hand, we can also see the different modifications of photos and videos that either manipulate the reality or are fictional. Based on such a large number of images, a space for 3D formation is created. In the past, the 3D art was presented in black and white animation or movie. Nowadays, a popular 3D art, with a variety of advanced options for processing images, enables to create any scenario for creative graphic artists or advertising and movie makers.

At the core of the mappind process, it is crucial to correctly create an object, which will not contain any various defects in the form of polygons. Such a model has a standard definition of solid colour. By mapping into space (u, v) and creating the 2D level of texture according to the map, such mapping area will be projected onto the surface of the object. In the final stage, such model will be lightened and placed into the environment. In case the animation is needed, the trajectory of the camera is set, so the process of creating the final presentation can begin.

Theory of mapping

Mapping is one of the essential activities in creating three-dimensional objects in software environment. It is an integral and very important part in modelling and texturing process of a 3D object. In the field of texture modelling and computer graphics, especially object modelling, the term mapping stands for the projection of the object surface into the flat surface (u, v) . The keystone of surface projection on a subject is the assignment of coordinates in the UV plane to each defined point in the XYZ space. However, the same rules apply for mapping as for the modelling, such as the aspect ratio preserving the lengths and the size of the individual polygons (the area from which the object is created). Mapping leads to texturing, where the defined texture (2D picture) will display in the space (u, v) (Figure 1) by using the created map. Figure 1 shows an expanded map of the Earth. This map will be applied to the sphere, which represents the Earth's surface. After adjusting the map to the surface of the Earth, it proceeds to texturing of a surface to achieve the most realistic model while preserving the length of the sides and the size of the polygons.

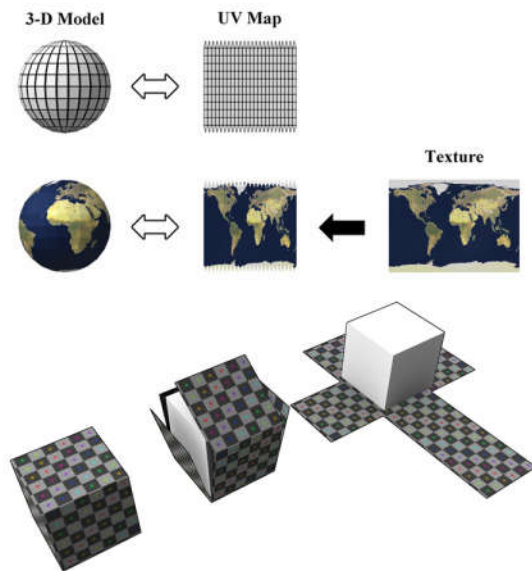


Figure 1 – World 3D model [1]

Mapping methods

In computing practice, we encounter different requirements in creating 3D models. However, it is more important to firstly look at the 3D model complexity rather than on the vision to be achieved. In terms of mapping and texturing, the model is differentiated into two categories based on its complexity:

- Simple model.
- Complicated model.

Simple model

Simple model is composed of the basic geometric shapes (box, sphere, cylinder) and in case of simple surfaces, the mapping is quite easy and straightforward process. Basically, it is about creating a suitable projection. In the program environment such as 3Ds MAX, CINEMA the basic projections are inducted to: Planar/Flat, Box/Cubic, Spherical and Cylindrical. It means that if the model is composed of the simple geometric shapes, as mentioned already above, then the mapping is becoming a very simple and fast process. Based on the size and shape, the projection will be determined, and the map will be automatically re-calculated. If we want to use these projections for a more complex object, then the software will not be able to map the object, and the entire mapping process fails.

Complicated model

For more complex mapping models, the process is much more difficult and time-consuming. However, in the area of software solutions, the modelling process gets better and better each year in order to shorten the time and make the process simpler. In the program environment such as ZBrush, 3Ds MAX etc., the process of complex mapping has been skipped. Therefore, an option was created to apply the mapping directly to the object. This method does not monitor or simplify this procedure, as in the programs presented within simple models. The ZBrush program offers two options on how to apply mapping without initially using a mapping layout (u, v). These are the Projection Master and Polypainting functions.

In the above mentioned ZBrush program, the Projection Master function works on the principle of projecting the object into 2D on canvas. At this point, the canvas is modified and then picked up again and re-projected onto the surface of the object. In contrary, Polypainting works right on the surface of the object and allows you to directly modify painting and texturing precisely on the surface of a 3D object.

In the 3Ds MAX program environment, an UNWRELLA plugin is created and the entire mapping process is automated there. In case of such complex objects, the texture is applied across the plugin. This texture simplifies and accelerates the process with relatively good results. The advantage of this plugin is the automated mapping, even though the user intervention is still needed.

In other software solutions, this entire process depends on a user. Thus, the focus is put on a user who, at the expense of the automatic process, must correctly set each step of the entire mapping setting.

Mapping in 3Ds MAX

Within mapping in the 3Ds MAX software environment, one of the most important tasks or techniques is a right location of the texture. If the texture was applied without mapping, the expected results would most probably not be achieved. Mapping in 3Ds MAX can be found under Modifies UV Coordinates function (Figure 2). In this folder, even more modifiers for mapping can be found, but usually a UVW Map Modifier is used for mapping according to basic geometric shapes.

After this, the process proceeds to texturing of more complex objects. In this case, the Unwrap UVW

modifier is used, and it contains two functional approaches to mapping the individual parts of the object (Figure 3).



Figure 2 – UV Modifiers

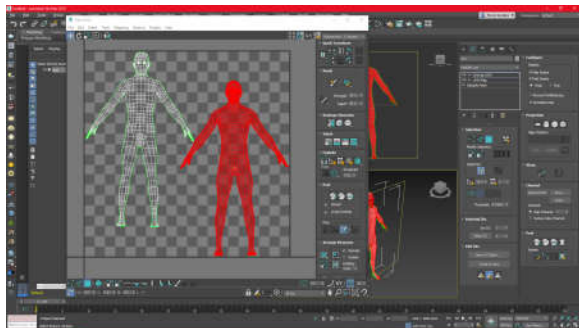


Figure 3 – UV Modifiers

The other modifier is called Pelt Mapping and is used to map the organic models such as human head or animals, etc. In this case, the mapping template is spread equally over the object in the seam locations. It is achieved by using a stretcher. On the perimeters of this circle are the vertices where the seam was defined. The primary function of this modifier is to spread a map over the object surface. The upgrade of this modifier came after 2012, when the Peel modifier appeared, based on the Least Square Conformal Map (LSCM) algorithm. This algorithm is based on automatically created UV map, and it is keeping the deformation and stretching to a minimum. The LSCM tries to maintain angles between the polygons at the expense of the scale. By moving the points in the LSCM, the desired result can be achieved.

Evaluation of mapping techniques

In each of the techniques mentioned above, it is essential to define the cut where the unwrapping process should be performed. Within the Pelt Mapping model, the map defining is relatively

simple. However, there is still an issue of the irregular configuration of the checkerboard. As a result of it, work with peak points is not persuasive due to the frequent usage and switching of these points. In contrast to Pelt Mapping, the Unwrella method is less complicated and faster, because it is an automated process. On a fundamental basis, it enables to map the object, but the problems may occur when it comes to the large and rugged surfaces (not sufficiently spread out into a plane). Another method of mapping was Peel's method, trying to replace Pelt Mapping. Mapping of the object in this case is also relatively good thanks to the LSCM method. However, work with peaks (fastening and removal) is still needed, which takes a lot of time depending on the complexity of the object.

Conclusion

Nowadays, the issue of mapping is a very current topic thanks to its impact in the game industry as well as in the digitalisation of different objects. The core of the object mapping remains in retaining a steady and natural layout of the mapping structure. In 3Ds Max program, there are some tools that can easily map the object, especially the simple one. However, it is necessary to spend more time on details in more complex objects. Postproduction of objects can also be determined based on user's know-how. Each user uses a selected type of software to achieve the best result. Therefore, while working on mapping, it is recommended to choose a software solution that will take as little time as possible for the user.

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