GALAXY INTERNATIONAL INTERDISCIPLINARY RESEARCH JOURNAL (GIIRJ)
ISSN (E): 2347-6915
Vol. 10, Issue 12, Dec. (2022)

CLASSICAL AND COMPUTER VISUALIZATION: PROJECTIVE TRANSFORMATION

Beknazarova Saida Safibullayevna
Prof, D.T.S., Tashkent University of Information
Technologies named by Muhammad Al- Khwarizmi

Anvarxo'jaev Sarvar A'zamxo'ja o'g'li
Magister, Tashkent University of Information
Technologies named by Muhammad Al- Khwarizmi

ABSTRACT

3D graphics is an indispensable tool when it is necessary to demonstrate any complex technical nodes, multi-stage productions, architectural structures. Three-dimensionality clearly displays all the features of the structure of the object, its smallest elements, and parts of the structure of the structure hidden from the observer's eyes. Three-dimensional graphics are considered an indispensable tool for demonstrating various kinds of complex technical nodes, multi-stage productions, architectural structures. Three-dimensional models clearly show all the features of the structure of the object, its smallest elements that are hidden from the eyes of the observer. At the moment, 3D images are the peak of perfection in the advertising and design industry.

Keywords: classical visualization, computer visualization, projective transformation

In classical graphics, in addition to parallel and perspective projections, many other projection methods are used, starting with the classical system of three orthogonal views and ending with two- and three-point perspective views. Such views allow you to convey the relationship between the object, the observer and the picture plane. In computer graphics, it is customary to perceive an object and an observer independently of each other, so many types of projection are not used in the visualization process.

Those who are fond of photography know that before photographing it is necessary to adjust the focal length of the zoom lens. The size of the frame depends on the size of the matrix and the characteristics of the lens. In computer graphics, there is a similar situation: which objects will be included in the image (will fall into the frame) depends on the choice of the type of projection and visualization parameters. In photography, a wide-angle lens gives the most tangible perspective: objects located close to the camera are larger in the picture than objects slightly removed from the camera. Conversely, long-focus lenses (often called telephoto lenses) hide perspective by equalizing the size of objects. They say that such an image is "flat", approaching in character to what is created by parallel projection.

The projection process can be considered as the transformation of a point (x,y,z) into another point (x_p, y_p, z_p) lying on the picture plane. The projective transformation is the mapping of a point of three—dimensional space into points of the picture plane (Fig. 1). Such a transformation is degenerate, i.e. the determinant of the transformation matrix is zero. All points located on the same projecting ray are transformed into a single point on the picture plane. For this reason, it is impossible to restore the original position, therefore, the transformation is irreversible.

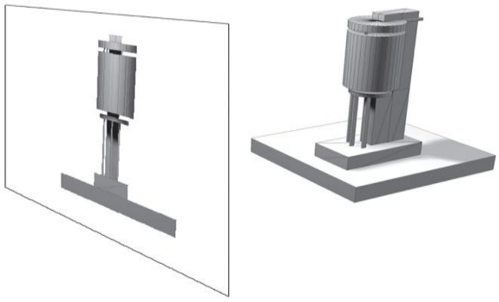

Figure 1. Projective transformation

In addition, it is necessary to take into account: the focal length (the distance from the CPU to the picture plane), the size of the picture plane window and the viewing angle. If the picture plane has the form of a rectangle, then only those objects that will be inside the pyramid with the vertex in the CPU will appear in the image. This pyramid is called the visibility zone. Objects that are not in the field of view are cut off and not included in the frame.

In computer graphics systems, the visibility zone is limited not only from the sides, but also along the projection axis: the near and far clipping planes are set. As a result, the zone takes the form of a truncated visibility pyramid (Fig. 2). At the origin of the frame coordinates is the projection center, the only rigidly fixed parameter.

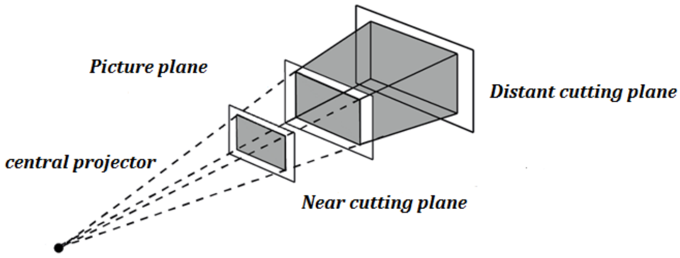

Figure 2. Visibility pyramid

In most graphical APIs, the clipping parameters are defined together with the projection method. It is not at all necessary that the parameters defining the left, right, upper and lower faces of the visibility pyramid are symmetrical with respect to the z axis. With parallel projection, the visibility pyramid turns into a parallelepiped of visibility.

Whatever the method of projection, the result must be normalized, i.e. brought to a single form. The approach used in the mathematical system is based on the projection normalization technique. This technique provides for the reduction of all types of projections to an orthogonal projection. To do this, a preliminary distortion of the original objects is performed (Fig. 3).

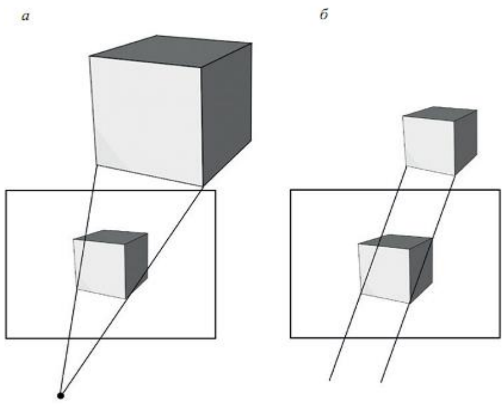

Figure 3. Preliminary distortion of the object: a — perspective projection; b — orthogonal projection of the distorted object

Since such a distortion can be represented as a transformation in homogeneous coordinates, it is possible not to actually distort the shape of objects, but to add the corresponding transformation matrices to the matrix of the usual orthogonal projection and obtain the matrix of the required projective transformation, as shown in Figure 4.

Since projection modeling is a key task in three-dimensional computer graphics, it is impossible to write a good application program or develop a new graphics system without a deep understanding of the mathematical methods used in this process. Moreover, although the functions of working with projective transformations that are available in graphic libraries give quite satisfactory results in most situations that arise in the practice of developing graphic applications, some types of projections, in particular oblique, are most often not supported. If you need to organize such a projection in an application, you have to resort to indirect methods, and for this you need a deep understanding of the mechanisms of the system.

REFERENCE

1. Kenneth, D.H. Practical Introduction to Computer Vision with OpenCV / D.-H. Kenneth. – Ireland: Trinity College Dublin, Ireland, 2014, – 234 p. – ISBN 978-1-118-84845-6.
2. Bernatovich A. S. An active experiment in the identification of functional systems for the operational implementation of simulation-type models//Cybernetics.- 1983. - No. 1. - pp. 99-104.
3. Anderson D. Tannehill G. Pletcher R. 1990 Vychislitelnya gidromehanika i petloobmen (Moscow: Mir) Moscow: Nauka)
4. Beknazarova S., Mukhamadiyev A.Sh. Jaumitbayeva M.K.Processing color images, brightness and color conversion//International Conference on Information Science and Communications Technologies ICISCT 2019 Applications, Trends and Opportunities. Tashkent 2019.