

RECENT ADVANCES IN THE APPLICATION OF 3D GEOMETRIC MODELING SOFTWARE WITH FOCUS ON LINEAR PERSPECTIVE

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A problem with difficulty of studying and understanding 3D geometry at secondary schools and colleges is addressed in this article. One possibility of improvement the understanding geometry is suggested - modeling with modern geometric and algebraic systems. The integration of computer modeling into the studying and teaching geometry is seems to be as efficient aid how to innovate the schooling of geometry and achieve better results. The application of geometric modeling software will be demonstrated on example of linear perspective - the central projection.

INTRODUCTION AND MOTIVATION

Descriptive geometry (Pottmann et al., 2007), the branch which deals with principals of geometric projections, is the main field of our interest. The techniques of descriptive geometry are very important for architectures, builders, technicians, designers or civil engineers.

I have my own experiences of teaching classical, descriptive, and computational geometry at Charles University in Prague – Faculty of Mathematics and Physics. The study of geometry is very difficult for some students. Our conjecture is that this is the reason why descriptive geometry and geometry in general does not belong among popular subjects. One unfortunate tendency in recent years in the Czech Republic is decreasing interest in studying this interesting part of mathematics. For improvement the understanding of the geometry of 3D space and for increasing the interest in geometry we suggest using modern geometric computer systems. Geometric modeling software in the education process can motivate students. The study of geometry becomes modern disciplines due to using computers and descriptive geometry regains the importance in technical practice.

In above mentioned areas one is often concerned with representing three-dimensional objects on a two-dimensional display planar surface. Descriptive geometry deals with those representations which are one-to-one correspondent and the 3D objects can be easily and clearly derived from 2D view. Let us summarize, there are two points of view. Firstly we construct the geometric projections of 3D objects onto the two-dimensional plane and secondly we have to be able to reconstruct 3D object from two-dimensional result of projection. In both directions we can use suitable computer software for illustrating the situation in 3D space, for planar constructions, for proving some geometric problems or for automatic creation of projections.

Let us provide important note. We don't propose the absolute replacement of drawings by hand with the outputs of modern computer software. We still have to know the basic principles and rules in geometry even though we use those software.

THE APPLICATION OF 3D GEOMETRIC MODELING SOFTWARE IN LINEAR PERSPECTIVE

The main principles of well known and widespread central projection – linear perspective can be found in (Auvil, 1996). Perspective projection is use for realistic representation of 3D objects in the two dimensions. The results of this special type of central projections are very close to images as

they are seen by the eye. These kinds of projections are widely used in graphic arts, for presentation drawings, for advertising, for visualizations of architectural design or technical devices.

Typical geometric task is to construct perspective projection of some 3D object or geometric situation in the plane by hand. Complicated 3D structure can be very difficult for sketching because in this phase we work only with the planar situation. We can do the construction in the plane also using the computer. In modern modeling software, we can also work with rotations and other transformations; we can change the view of a designed object. Understanding the basics of linear perspective also improves our ability to find appropriate perspective views.

Let us show construction of perspective view of 3D real object - suspension Bay Bridge. The task is to construct perspective view of bridge and its reflection in water. To generate perspective image of bridge by hand is quite complicated. We did this construction in the plane using computer for more precise result, see figure 1 (left). We use known principles for creation of perspective view and display only a few lines and curves which are used for constructions. Geometric modeling software we use also for illustration the spatial situation, for demonstration the principals of perspective projection, see figure 1 (right). We made figures in software Rhinoceros.

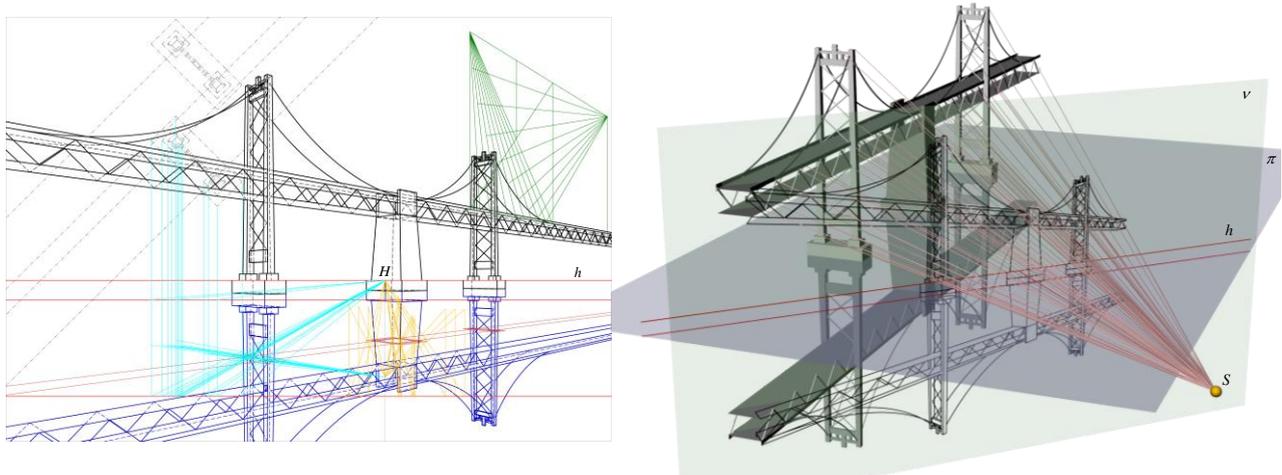


Figure 1: The result of perspective projection of Bay Bridge (left) and spatial situation and principle of perspective projection (right).

CONCLUSION

In this contribution we suggested the use of computer modeling software in the studying geometry. Suitable software can help us for better understanding geometric situation in 3D space. Another examples of 3D modeling can be found in (Surynková, 2011; Surynková 2012).

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