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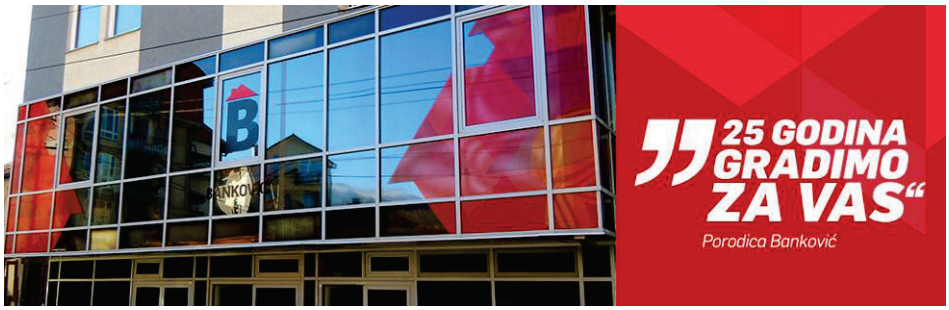

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3D ANIMATION APPLICATIONS IN DESCRIPTIVE GEOMETRY TEACHING

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Aleksandar Čučaković[2]
Biljana Jović[3]

Abstract

The use of digital technology includes an interdisciplinary approach. The focus is on fusion of different media and genres into new forms of artistic expression as well as transcending the boundaries between art and education, the arts and research.

Teaching descriptive geometry using animation softwares enables development of the ability of spatial representation, perception and understanding of space. The specific contribution is in the education by working with 3D animation for students of art and engineering field of technical - technological group of students. We emphasize the importance of dealing with design dynamically- generated form.

Experimental design (freeform) presented on DVD includes: generating a surface with the two profiles as guidelines, generating free form using lattice deformers and generate free-form by the duplicating along curve tool.

The key concept of dynamic geometry is to select the item which is then changed position and simutaneously you can see changes in the structure. This ability of movement is fundamentally improvement regard to the drawing on the paper or static CAD models.

The movement in animation is captured by sequence of static pictures. If we have the form which changes during the time, we could observe these changes also sequentially. On this way, the form cloud

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be observed during the morphing in time, and each particular frame could be the base for further development.

Key words: *Descriptive geometry, education, computer animation, experimental design*

1. INTRODUCTION

New standard in geometry education is the use of multimedia tools in educations of descriptive geometry. For practicing more complicated operations and for analyzing the different forms, their arrangement as well as their relationship within the space the application of computer animations in education through experimental design could be used [1].

This paper is important research in the field of application of methodological innovation in the area of space geometry and computer animations with the focus on geometry education in visualization and experimental design.

Improvement of spatial ability, ease of application, pedagogical stimuli for users in terms of encouragement for the further geometry exploration is provided by the applicability of dynamic 3D geometry in education.

The proposed form of educational environments is a new opportunity for teaching and learning of descriptive geometry.

2. GEOMETRICAL EDUCATION

Development of the ability of spatial representation, perception and understanding of space is enabled by descriptive geometrical education.

In the scientific hierarchy descriptive geometrical education is placed in the field of architecture, as well as with the field of mathematics, mechanical engineering and engineering graphics. Geometrical education is definitely important for all engineers, artists, and physicists as well as natural sciences students since enables perception of space abilities training [9].

3. CONSTRUCTIVIST THEORY

Constructivist theory is the base for this paper. Cognitive theory known as constructivism emphasizes that learners construct new knowledge by rearranging and refining their existing knowledge.

Valid and reliable basis for a theory of learning is provided by constructivist theory. Learning process is carried out when students are able to build conceptual models that are in accordance with what they already understand and with new content, as constructivism emphasizes. Basic principle commitment to constructivist position includes that knowledge is not transmitted directly. New experience of learning the flexible learning path must be provided with the aim to provide the successful implementation of a constructivist theory.

4. 3D DYNAMIC GEOMETRIC SOFTWARE

3D animation software have become common tool for educating, initiating the development for training and experimental design [10]. The specific contribution is in the descriptive geometrical education by working with 3D animation for students of art and engineering field of technical technological group of students. The importance of dealing with design dynamically generated form is emphasized in this paper. CAD applications have similarities with the dynamic geometry software, for example in prototype construction that can be quickly adjusted as well as it could be used for quickly and easily construction of a simple model as a start from the further parametric design and prototype production. Precise construction is support by many CAD applications. Among the best known are: Rhinocerous, SolidWorks™, Autodesk Mechanical Desktop™, Catia as many others. For digital 3D animation software the aim is not to be precise but to produce the animation. Comparing with CAD programs which purpose are to draw and construct precisely and produce the prototype, the 3D animation final product output is IMAGE. The emphasis is on ease objects manipulation in 3D space, and simplified controls for construction, which are especially important for modeling the so-called organic models. 3D multimedia learning DVD is done in this kind of software because of the main above mentioned reason why the animation used for it. The most well-known programs for 3D computer animation are: Blender, Autodesk Maya, Autodesk Softimage, Autodesk 3ds Max, and others. Considering that our paper relates to the 3D animation

application in the descriptive geometrical education, the areas of 3D animation follows [13].

5. CONTENT OF THE MULTIMEDIA DVD

The educational multimedia DVD learning tool consist of 16 animations, which approximately duration about 5 minutes. Descriptive geometrical areas are:

1. Platonic solids: cube, tetrahedron, octahedron, dodecahedron and icosahedron (Figure 1)

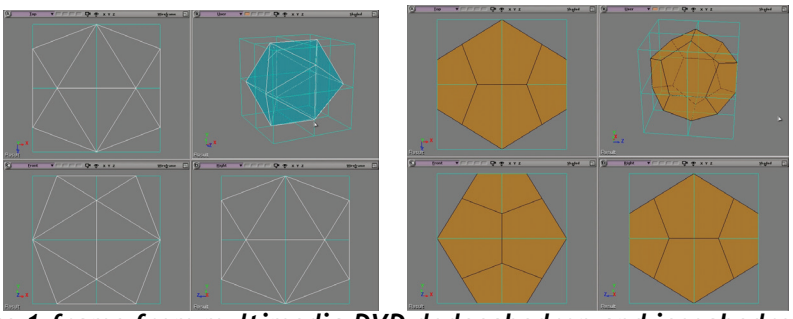

Figure 1.frame from multimedia DVD dodecahedron and icosahedron

2. Ruled surface: conoid, rotational hyperboloid (Figure 2), helicoid and hyperbolic paraboloid (Figure 3)

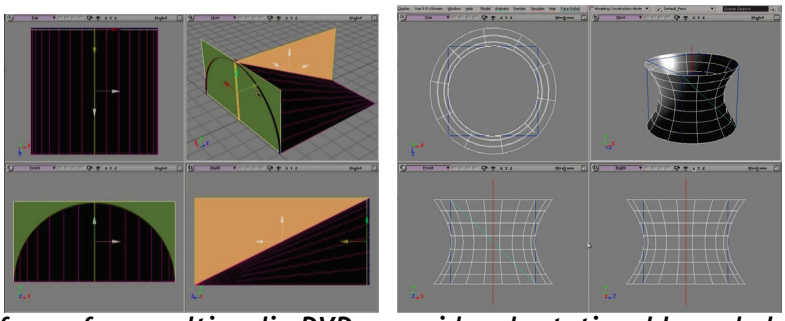

Figure 2. frame from multimedia DVD - conoid and rotational hyperboloid

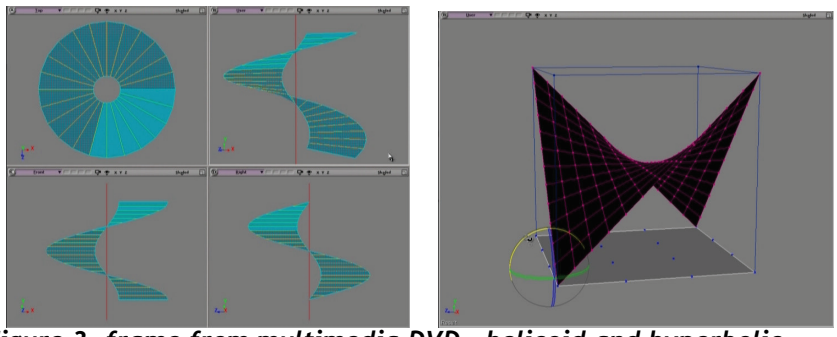

Figure 3. frame from multimedia DVD - helicoid and hyperbolic paraboloid

3. The surface of revolution: the torus (Figure 4)

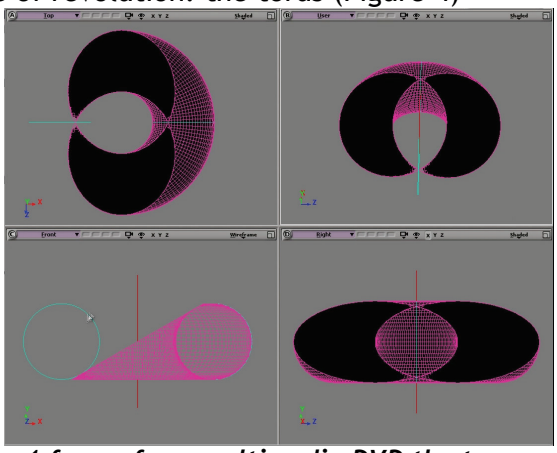

Figure 4.frame from multimedia DVD the torus

4. Mutual intersection: conic sections, cone and cylinder, sphere and cylinder and two half-cylinder (Figure 5)

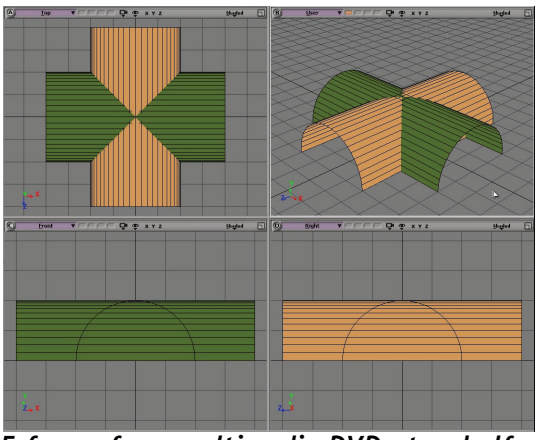

Figure 5.frame from multimedia DVD - two half-cylinder

5. Experimental design (freeform):

Generating a surface with the two profiles curves as guidelines (Figure 6),

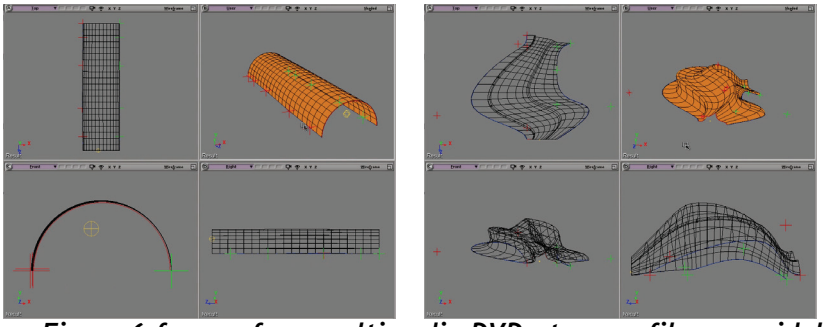

Figure 6.frames from multimedia DVD - two profiles as guidelines

Generating free form surface using lattice deformer (Figure 7)

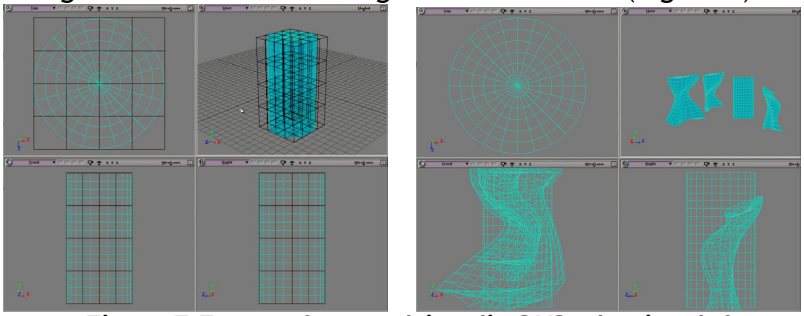

Figure 7.Frames from multimedia DVD - lattice deformers

Generating free-form surfaces with duplicate along curves tool (Figure 8) [2].

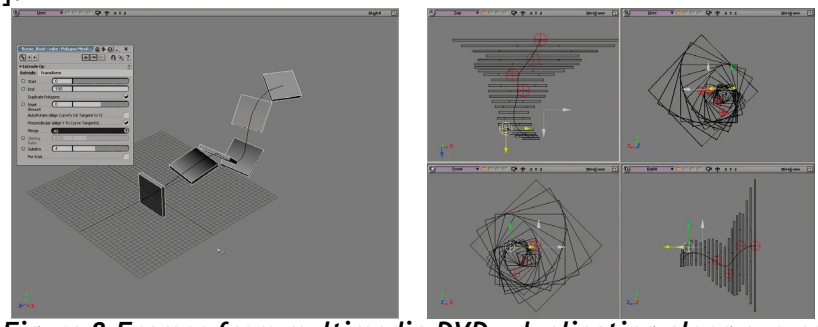

Figure 8.Frames from multimedia DVD - duplicating along curves

The basis for generating spatial structures and constructive systems are Platonic solids. Ruled surfaces are heavy understanding in the 2D image while the easiest to generating by using computer animation tools for 3D animation. Intersections and the resulting intersection curves as well as intersecting surfaces are delicate and their perception is the easiest in these kinds of applications. Besides the easy perception and learning, the students are also motivated to repeat the same process and to continue to explore the topic.

Short animations are the final presentation of our work on multimedia DVD. The whole process is directly recorded in 3D software. Every animation has additional text that follows and explains the procedure and gives the basic definitions.

The aim is to demonstrate the potential of 3D geometry education by examples which are different in difficulty but all belong to the descriptive geometric area of the university educational levels. Dissimilarity of selected areas has shown how the different geometrical areas may be processed in the virtual environment by using computer animation. The animations from multimedia DVD represents: the application of Boolean operations (subtraction, union, intersection) in mutual relation of solids, the study of revolved surfaces and their geometrical properties; the study of curves and surfaces 2nd sort (intersection curves of two cylinders); regular polyhedra and their relationships; ruled surfaces and surfaces of revolution; free form.

6. CONCLUSION

Descriptive geometrical education by using 3D animation supported different learning tools for students from auto didactical to guide by teachers as well as more autonomous way of learning.

Computer animation represents the standard in education. This kind of learning tool allow students, teachers, artists, researchers, engineers, designers, etc. empowerment in all field of work, from education to practice[11].

Computer animation in the function of descriptive geometry learning tools offers new and fascinating possibilities. Users can explore the most diverse theoretical and practical problems with the aim of understanding the dynamic and complex spatial relationships. Users of this kind of teaching material research communicate and understand the spatial problems in different ways. It is possible to teach with objects in a simulated environment and to learn through movement, and immediate response [3].

Teaching and learning by using multimedia DVD stimulates a communication between teachers and students which were not possible at conventional ways of teaching [8]. The use of computer animation in the teaching related to the descriptive geometrical education improves and greatly speeds up explanations of teachers intentions [4].

Experience in the use of computer animation in geometrical education in the learning process demonstrates significant progress in the perception of huge possibilities working with each model. Today's conventional hardware and software packages allow the use of computer animation quite simple. One, between many of observed advantages of usage of digital multimedia geometrical education are that enables the exchange of theoretical and practical knowledge among participants in the distanced locations. Computer animation is good platform for teamwork. Participants in educational process using interactive media, which includes design and communication at a much more direct way than simple file sharing. Teachers and students showed a higher level of interaction and the working possibility are multiple. The processes of thinking, creating and understanding in communication are enhanced through a media that allows the joint participation. Computer animation as a learning tool establishes a unique combination of collaboration and communication of interactive teaching process that is transparent and directs [5]. Users of digital multimedia geometrical learning tool have tremendous opportunities

to explore spatial relationships and geometrical characteristics of the topics being processed in this paper [6].

Especially important is dynamic educational experience in a virtual environment. Animation as a new dimension in geometrical education by using of dynamic geometry education achieved much higher insight into the actual structure and construction, because through the movement directly experientially we learn about the changes in the construction of the structure. This kind of innovative approach leads to new form of design. The usage of tools for 3D computer animation open up new perception of the tangible existence of geometric forms, all in motion, as well as the sensational dynamic manipulation of the geometry [7].

The original contribution of this paper is in the implementation of transdisciplinary hybrid approach, overlapped several disciplines such as architecture, descriptive geometry, computer animation and programming.

9. ACKNOWLEDGMENT

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