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MONGE'S METHOD AND CONTEMPORARY GRAPHICS

Summary. Contemporary graphics, as well as the majority of other engineering disciplines, confront some technological problems, connected width the formation of informational society the foundation of which is computerizing:

- educational graphics problems have not changed in the main;
- needs and practical possibilities have changed thoroughly (2D changes into 3D) and have been developing rather quickly;
- time of studying has been shortened.

It is not possible to solve these problems by traditional and indeterminate methods because pedagogical practice does not have successful analogues. The paper presents the main graphics themes, solving of projection problems by modern means and the role of Monge's method in it.

METODA MONGE'A A WSPÓŁCZESNA GRAFIKA

Streszczenie. Współczesna grafika, jak również większość innych dziedzin inżynierskich, napotyka pewne problemy technologiczne związane z powstawaniem społeczeństwa informatycznego, a podstawą tego jest komputeryzacja:

- problemy nauczania grafiki nie zmieniły się znacząco,
- potrzeby i możliwości praktyczne zmieniły się dokładnie (2D zamienia się w 3D) i rozwijają się raczej szybko,
- czas studiów został skrócony.

Nie jest możliwe rozwiązanie tych problemów tradycyjnymi i pośrednimi metodami ponieważ w praktyce pedagogicznej nie znajdziemy udanych analogii. Artykuł przedstawia główne tematy graficzne, rozwiązując problemy rzutu za pomocą nowoczesnych środków z uwzględnieniem metody Monge'a.

1. Introduction

Revolutionary developing informational technologies created some myths, the role of which is very often bigger than it should be. One of such myths is that computer can do everything, that is why on this basis much from the old subjects is

crossed out. As a result, less attention in universities is given to graphics subjects and, therefore, less time is allotted for them, though it should be on the contrary.

The second myth is that it is necessary to renew constantly the knowledge about computer systems. That is why mast often the rules, forced by commercial firms, are studied but not the essence of the subject. Users spend more and more time to study the constantly becoming complicated systems, but they, regardless of users efforts, only move away and estrange from them.

The experience of the decade showed [1] that having formulated the graphics problems and having prepared computer methods to solve them, the methods of solving did not depended on the change of commercial systems. On the contrary, some things of the methodology offered were presented by commercial systems much later [2]. It is know that 10 years is a very long period in computer science, so this fact practically denies the second myth. It is determinated in the paper that there is a stable integrity of graphics and computer science knowledge which practically does not depended on the level of computer science development what denies the first myth.

2. Projections essence and Monge's method

Computer technologies changes the relations between quantity and quality of practical knowledge about projections, because the computer, automatically performing the projecting operation, leaves to user only the problems of an evaluator type, quantity, placing of projections and other similar organizational problems. Of course, the user should form a three-dimensional model of object. Sometimes projections help to do it, but some part of the information will be always produced on paper, and the ability to get the data from projections will be also useful in future. In communication with the help of paper information it is necessary to keep to the certain order. Besides, the rational types of management 2-dimensional views are formed.

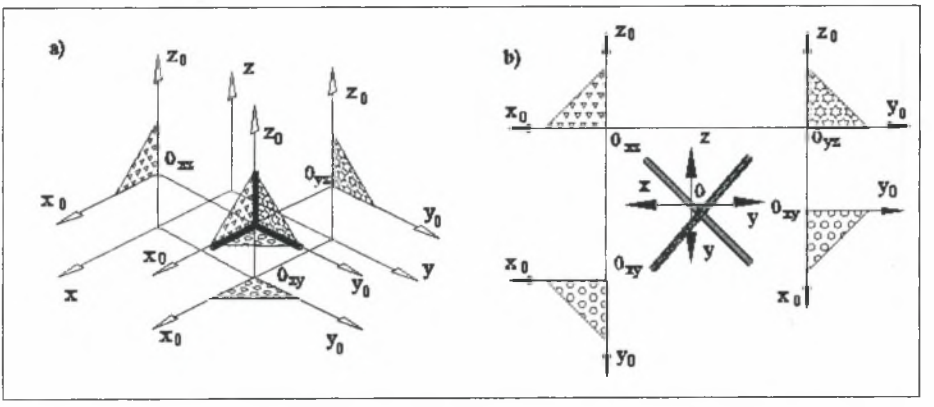

Fig. 1. The essence of the projections:a – the coordinate system, b – projections
Rys.1. Istota rzutów: a – system współrzędnych, b – rzuty

The aim of projections is to produce a three-dimensional view of object in a 2-dimensional field, that is to produce the information about the object when the dimensions in the process become smaller. The problem is that it necessary to decrease the dimension preserving identity, and the solutions of this problem are reflected in the applied method. In educology it is connected with traditions and technologies the application of which, in its turn, causes objections.

From Fig. 1b it can be seen that Monge's method is excessive because after eliminating the coordinates of projection planes, information bearing of the drawing doesn't decrease, and the graphics of the method becomes identical to the method of coordinates. Besides, using Monge's methods the transformations are carried out by a projector manipulating by the scheme of the method (Fig. 2a) and by the object coordinates, while using the coordinate method [3] only the coordinates are used which are rearranged by computer automatically (Fig. 2b).

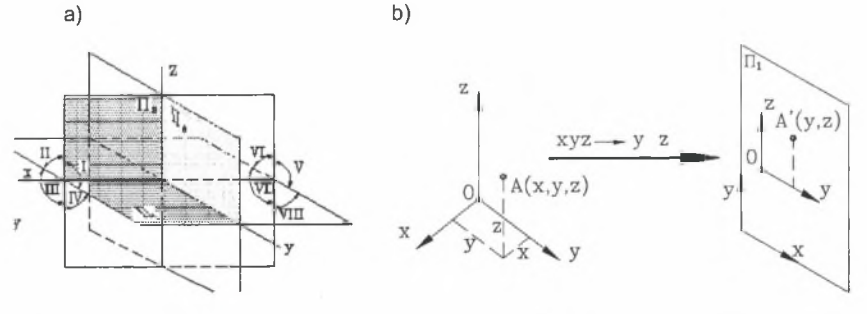

Fig. 2. The projection mechanism: a – Monge's method, b – the coordinate method
Rys. 2. Mechanizm rzutowania: a – metoda Monge'a, b – metoda współrzędnych

The rearrangement is carried out with the help of usual transformation matrices (Fig. 3). The reflections of three-dimensional objects (drawings, photographs, pictures, holograms) can be received during projecting. The object itself, projection plane marked by the letter Π with the index corresponding to the number of views and visualization technique take part in the process of reflection receiving. A' projection of A to Π_1 plane can be received as the projection ray i going through point A ($i \supset A$) which intersects with projection plane Π_1 - $A' = i \cap \Pi_1$, $i \supset A$. This way of receiving the reflection illustrates the essence of the classical method of projections, but it is not convenient and not used in practice because of some reasons.

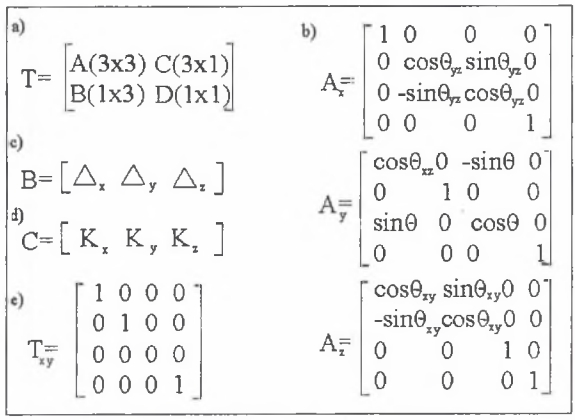

Fig. 3. The Matrices of geometrical transformations: a – generalized, b – the matrix of rotation about x, y, z axes, c – the matrix of transferring
Rys. 3. Macierze przekształceń geometrycznych: a – uogólnione, b – macierz obrotu wokół osi x,y,z, c – macierz przekształcenia

Firstly, the object takes a certain position in the space determined by x, y, z - coordinates, while the plane surface of projections (a computer screen or sheet of paper – a drawing field) has its own 2-dimensional coordinate system. The fact that some projections of objects with, not large dimensions can be placed on one sheet, complicates the situation with coordinates, while in 2-dimensional xy drawing field all three coordinates are used, thus being oriented in their different directions. So starting to learn projections always causes confusion. Besides, in computer without 2D drawing field you can also use 3-dimensional modeling space where the created object is visualized on the 2-dimensional screen.

Secondly, in the pre-computer period the coordinates were auxiliary because it was a draftsman who performed necessary calculations. In computer the coordinates

become of main importance because it is impossible to make a drawing with the help of computer without showing digital sizes. Only the choice of the corresponding coordinate system allows to do the majority of tasks in a simple way.

Computer views are received with the help of geometrical transformations when the coordinate system of an object is evaluated into the plane surface coordinates of projections. Geometrical transformation embraces the changes of position, size, orientation, form and reflecting which are received by performing actions with the coordinates. For describing objects in mast cases the orthogonal coordinate system is used (any other system can also be transformed into the orthogonal coordinate system). It is convenient to unite the computer set of coordinates into matrices, while geometrical transformations can be carried out by multiplying of matrices and adding up of vectors.

The transformation mechanism is thoroughly examined during the course of computer (digital) geometry. Only in graphics the corresponding tools are used. It is not necessary for a user to understand the system of receiving views, it is important to know how to get a desired result. Computers perform geometrical transformations according to the mathematical model of a formed object by showing the parameters of a necessary view. Views can be received either by choosing the projection plane in correspondence with the coordinate system of the object (Fig. 4a) or by moving the object itself in the space in correspondence with the projection plane (Fig. 4b).

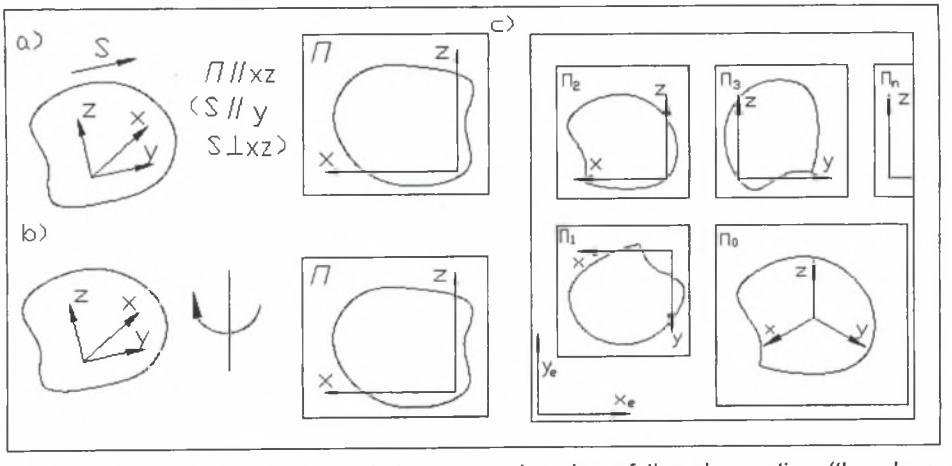

Fig. 4. The computer projection technique: a – choosing of the observation (the place of projection plane), b – moving of the object, c - views

Rys. 4. Technika rzutu komputerowego: a – wybór obserwacji (miejsce rzutni)), b – poruszanie objektu, c - widoki

The way of making projections when the object is connected with the convenient coordinate system, and then the corresponding coordinate planes xoy (xoz, zoy as needed) are made parallel to projections planes by rotating the object, are called the method of coordinates. The method of coordinates is convenient because it is possible to visualize automatically in real dimensions these elements in the projections which are parallel to projections planes. The coordinate system of the object is chosen to be the one that the wanted dimensions would be parallel to one of the projections planes. We can chose as many auxiliary convenient coordinate systems as we need for understanding the geometrical shape of the object. The method of coordinates is used for drawings which are carried out in the process of real design.

3. The essence of basic graphics course

Technical (engineering studies) graphics includes descriptive geometry, engineering drawing and methods of computer graphics. In different countries and schools the subjects can be named differently but the main point is the following:

- visualization of three – dimensional objects on a plane (a sheet of paper or a screen);
- view analysis and synthesis by graphics methods;
- methods and traditions of drawing making and designing.

Nowadays there are two tendencies in studying graphics disciplines at our and foreign universities:

- the absolute majority of practical tasks are drawn with a pencil, and at the end of the course some tasks are done with the help of a computer, everything being visualized by pencil methods which completely or mostly ignore capabilities and advantages of a computer;
- al the practical tasks are done with the help of a computer using the features of computer aided drafting, automating routine operations and making the computer work as much as possible to use its intellectual features.

For the reconstruction of the course it is necessary to do the following:

1) to choose the basic parts of the graphics discipline which don't depended on the level of technical equipment and which are universal and always necessary;

2) to eliminate unused and obsolete notions;

3) to develop software, otherwise the course can't be practically realized.

Applied graphics is an engineering branch realizing scientific – technical information in the geometrical – graphical form and solving the corresponding problems (shaping, displaying, transforming and representing) by graphical methods using modern facilities. These problems are being considered now in the courses of descriptive geometry, drawing and computer graphics. In this consequence it is inevitable to have repetitions and consideration of minor graphical methods.

The applied graphics completely covers the course of engineering graphics in Technical Universities but has following differences:

- computer methods of graphical problems solving are used from the first studies of descriptive geometry;

- construction of projections is based on using object – manipulating method the technology of which coincides with engineering practice and computer technology;

- construction of geo – objects is based on a structured frame form of description which is a geometrical basis of parameterization logically and mathematically documenting the dimensioning;

- graphical problems are classified, the algorithms of their solving given, due to which graphical methods become the basis of computer technology;

- all problems, algorithms and methods concerning the theory and practice of their realization, are connected by the unique methodological basis. The applied graphics is not a computerization of separate problems and techniques, but it is a computerized methodology and engineering of the branch of graphics;

The computerized engineering gives as a matter of fact, new possibilities which fundamentally change the work with graphic information:

- creation or using for any practical work the environment providing comfortable and intelligence surroundings;

- passing to computer the rough work of realizing monotonic operations in creating, searching, filing, etc;

- computer – aided analysis of drawings;

- both programming and graphical practice;

- intelligence in developments and applying.

The practice shows that in modern graphics the graphics programming gains special importance as it solves the following problems:

- drawing of parameterized objects;
- modeling and realizing of rough operations;
- geometric modeling and visualizing together with bases of both graphics and other data.

4. Conclusion

The specific features of the syllabuses should be considered as the following ones:

1) The peculiarity of computer aided drafting is that different graphics tasks are made by the software (for example, the suggested TAIGRASI) which is specially adapted for this purpose. You should always remember that the basis of computer aided drafting is not primitives but using the objects of different automation levels whit the help of parametric instructions.

2) In the universities plans (and in the majority of modern manuals [4-7) there are codes of programming systems (AutoCAD10, AutoCAD11..., AutoCAD2000..., WORD2, WORD7, etc.). It shows that universities teach not fundamental knowledge but follow constantly changing programming systems, thus adopting the functions of qualification courses of the corresponding firms. These who run after can never take the lead. Each subject at least at universities should be illustrated by the corresponding instrument, only in this way it can be improved and developed, and a university graduate will be able to think in a new way, create and work successfully.

3) A computer is not an ordinary instrument but it is a method and way which enables a tenfold raising of intellectual and physical abilities of a person. The peculiarity of automation is that the process which has begun does not stop and an ordinary user does not have to begin at zero. What has been once done well (basic systems reflecting and realizing the essence of the subject but not the intentions of firms) should become the achievement in the future and fundamentals of studies.

The generalization of theoretical achievements and technical possibilities of modern graphics on the border of 2D – constructions and 3D – modeling is in the manual [1].

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Abstract

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