PECULIARITIES OF GEOMETRICAL DRAWING IN CONTEMPORARY ENGINEERING GRAPHICS

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Abstract. So far computer educational engineering graphics has been using not all its possibilities , because it is based on obsolete visualization methods. Formation of a new conception and technology is based on two conditions: (1) the requirements and tasks have changed in computing, so the studying of traditional methods became useless, because those methods are not used in real life; (2) the possibilities of graphics have also changed. The automatic analysis of computer drawing is possible nowadays, that was impossible using traditional technologies. Besides, additional engineering information can be attached to computer drawing. Consequently, graphical content gains essentially new informative possibilities. The new outlook of graphics should be rebuilt in justice to positive aspects of traditional things and new possibilities of information technologies. This task can be solved by modelling information engineering graphics (IEG) and all its component parts. In VGTU an IEG model is evolved, which include a common and a special part. The common IEG part includes information geometric drawing, surface and volumetric modelling, interactive and automatic generation and/or modelling of projections and information building drawing fundamentals. The models of information geometrical drawing are presented in this paper. Those models are the foundation of 2D graphics.

Key Words: Computer graphics, information engineering graphics, graphics programming, data exchange technology, drawing database, artificial intelligence, Visual LISP Application, formalization of design problems, CAD program development.

1. Introduction

Geometrical drawing (GD) in computer science is such a visualisation process which is executed in two dimensional space, when desirable view is made in a graphical way without any calculations. By applying computer science it is possible to extract not only graphical but also additional information from 2D drawing; many other drawing tasks can be done automatically. Therefore, the role and purpose of graphics changes so much that it can be named information geometrical drawing (IGD).

The solution of GD tasks is necessary in solving different academic or engineering tasks, its graphical part (material mechanics, mathematics, building mechanics and so on), consequently it becomes a basis of successful studying and engineering practice.

Traditional methods are properly described in many course books, we would like to note [1-4] among the newest. Despite computing possibilities, traditional methods are applied nowadays [5-7], what is hardly rational. Computer science enables to transfer to computer a fair amount of tasks and even knowledge, so it is useful to model and solve information technologies which use maximum of computer's possibilities.

IGD model inclusive of visualization and all involved processes consists of the following parts:

- elements visualization (lines, circles, texts, dimensions groups, etc.);
- graphical symbols (inclination, conicity);
- osnap modes (intersection, midpoint, tangent, etc.);
- transformations (scale, rotation, mirror, etc.);
- execution possibilities (multielements: circles, perpendicular, etc.)

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The amount of members, who take part in drawing creation, changes in computer science. In traditional geometrical drawing (TGD) Designer – Traditional drawing tools – Drawing (Fig. 1), in information geometrical drawing (IGD) the amount of members is wider, and traditional tools are needless. It results in new tasks and problems. There appear computer technologies the main operations of which are drawing, modifying and service. These operations are connected not only with graphics, but also with mathematics and informatics.

In IGD model it is advisable to estimate that:

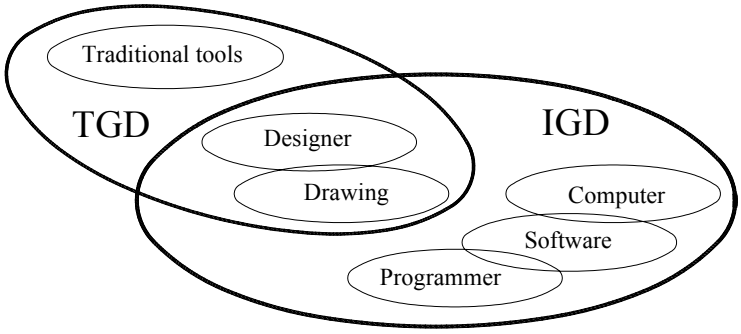

Figure 1. Members of TGD and IGD

- computer science allows us all operations which can be formalized, for example drawing field preparation to accomplish automatically;
- commands can be as rational in as much as they correspond to practical needs, so we have to be aware that the basic feature of software optimality is not the amount of commands, but their fulfilment of solving tasks.
- the proper software should be used for solving proper tasks, while minimal attention can be set to study general computer science and the main efforts – to achieve graphical result.

Since computer equipment can do many tasks according to the information cumulated in it and this information is not reliant on user's skills, the modelling of computer equipment managing is very important. The experience of many years work shows that tools of commands managing are placed rationally, it allows to work comfortably even on a small computer screen. The offered tools set is presented in Figure 2.

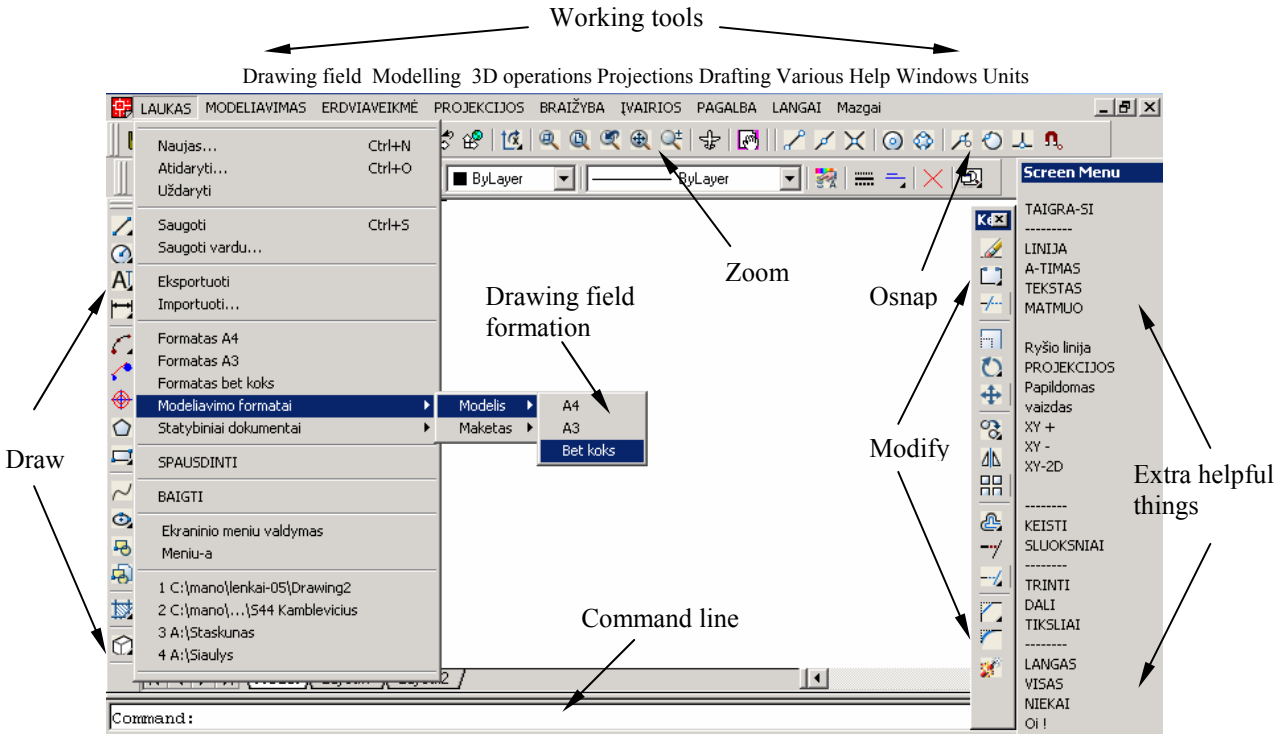

Figure 2. The scheme of computer tools.

Abundance of tools and operations is obvious. Differences between TGD and IGD can be seen even better in working (on/out)consecution models. There are two members in a TGD – a user (designer, constructor or so) and a drawing (drawing field), where user himself has to do proper tasks following the theory (Fig. TGD).

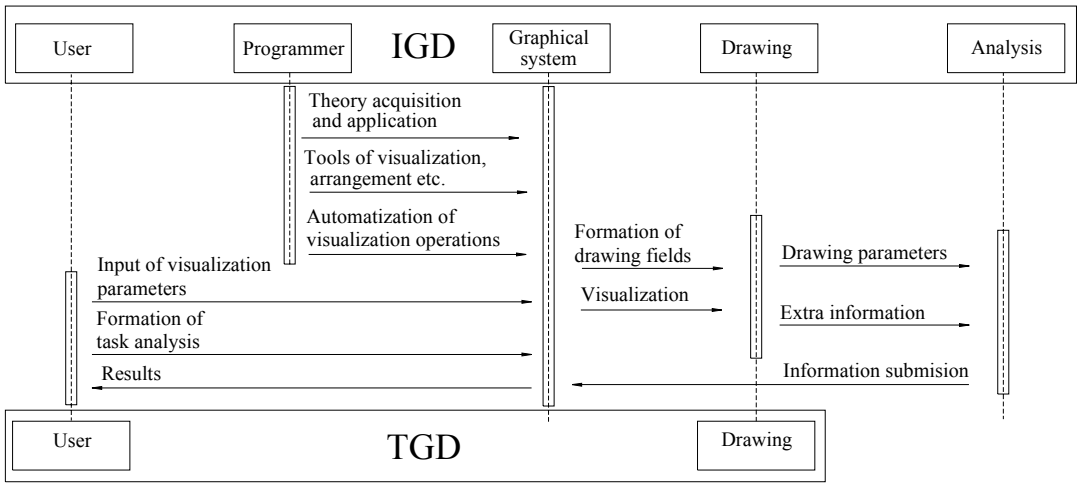

Figure 3. IGD and TGD action models

The situation is changing substantially in applying computer methods because there are more actors in the process. Besides a user and a drawing, a programmer and a graphical system appear who can do a lot of operations, including drawing analysis (Fig. 3 IGD). That determinates the technology because the process becomes bidirectional.

Differences between operations and members can be seen in action models and they are so marked that they request essential reformation. The computer presence in the process makes it not a tool, but the model of an action that has to be solved.

2. IGD structure modelling

Action model moulds IGD working model (Fig. 4) which has three parts: goal, content and software (equipment). These parts are the same for any graphical models, only content elements and software functions change.

The goal of computerised work in educational process and practical use consists of skill, facilities and practical use.

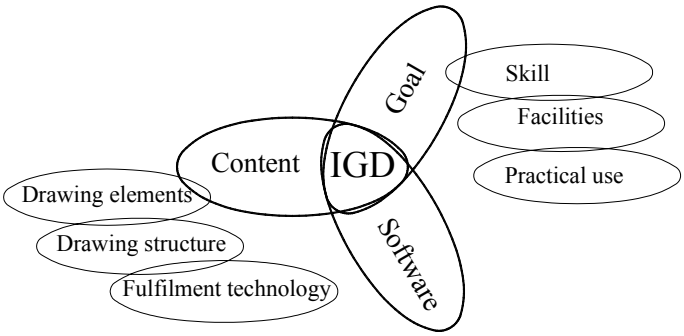

Figure 4. IGD working model

The model of computer-aided geometrical drawing, inclusive of visualization and all related processes, consists of three groups:

- Drawing elements (Fig. 5);
- IGD drawing structure (Fig 6);
- IGD fulfilment technology (Fig. 7).

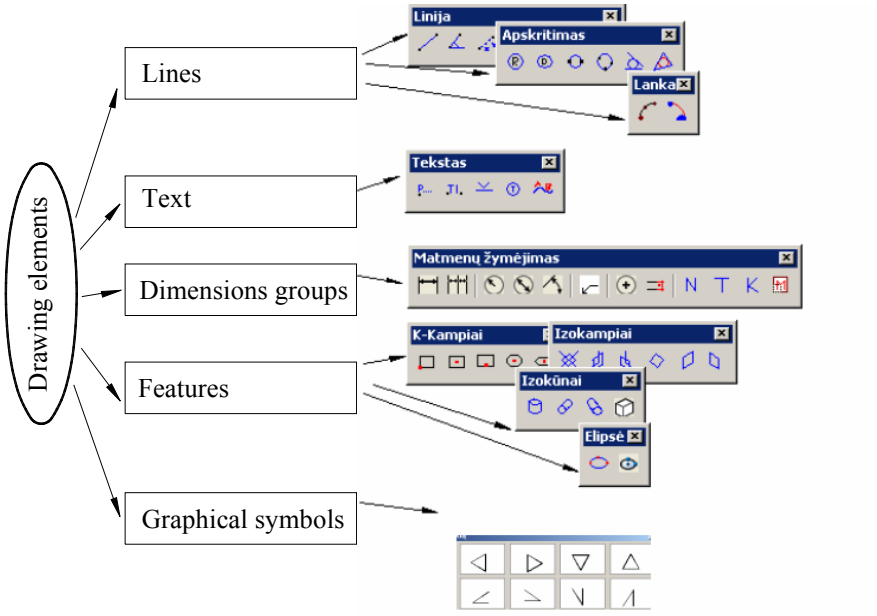

Figure 5. Drawing elements and visualization.

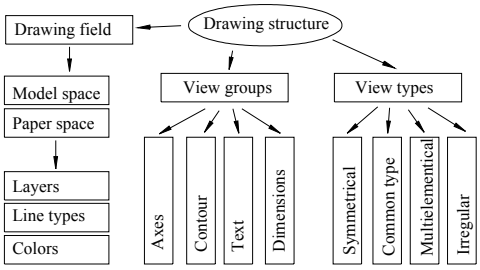

Figure 6. Drawing structure.

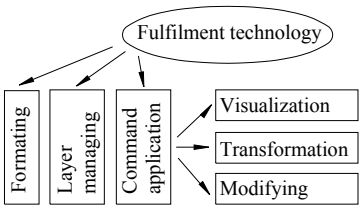

Figure 7. Working technique

Drawing elements which have well made commands make visualization more simple as we only have to know their possibilities and use them rationally. In that case the application itself raises no problems at all because computer science lets transfer all application difficulties to computer.

In detail drawings there are such specific elements as inclination and conicity which have adequate graphical symbols (Fig. 8a). Commands by inclination or conicity value (Fig. 8b) visualize objects and write proper graphical symbols (Fig. 8c). It is more simply to do by solid in a programmable way than to explain that every time or visualize in an interactive way.

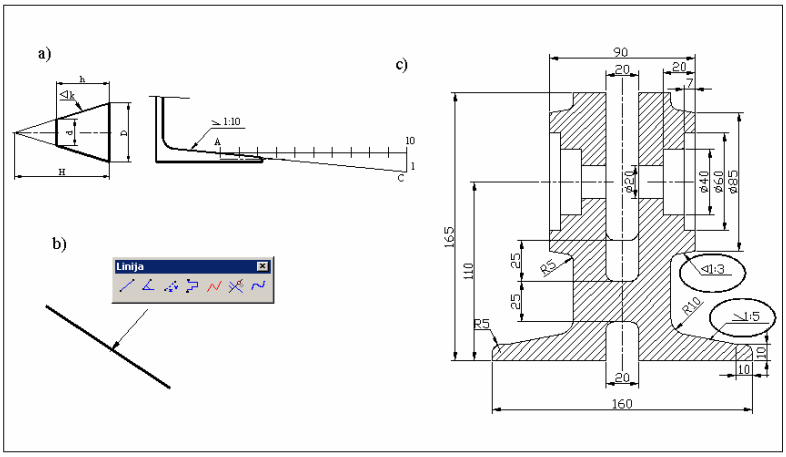

Figure 8. Automatization technique

Further automation process makes possible to apply the functions unrepresentative in TGD. The conversion of drawing view (Fig. 9a) into physical content (Fig. 9b) is possible now. During the conversion process view lines are converted to cross-section which allows to estimate perimeter, area and other geometrical parameters (Fig. 9c).

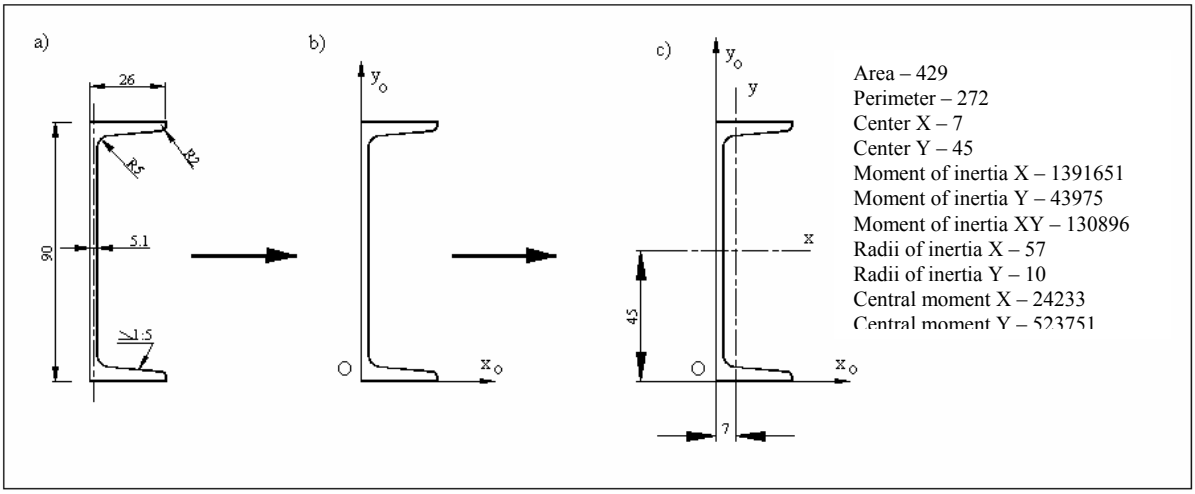

Figure 9. IGD possibilities.

Computer science allows us to perform multiple formalized and common operations, which can be found in both geometrical and projection drafting tasks. For this purpose they use the commands of multiple elements visualization, multiple circles from one centre visualization and a command for elements placement according to polar or rectangular systems. These operations were developed during some decades [8-10]. No doubt, new possibilities will appear in future because of computer hardware and software development, but nowadays the amount and type of commands are becoming stabile, as in the case with working stages which can be the following:

1. Drawing field formation (drawing field limits: A4, A3, etc., layers, line types) – can be done automatically, by using proper command.
2. Drawing analysis (contour type, determination of sequence) – performed by designer.
3. Visualization. Proper commands using (polygons, multielements and other) – performed by designer.
4. Control, trash removing, can be done automatically, by using proper command.
5. Formation of analysis.

Conclusions

- The models of graphics action show that application of complete computer science possibilities changes the content of graphics substantially, therefore new methods of realization of graphics are necessary and they differ from classical geometrical drawing;
- Special role is played by software which should be adapted for solution of proper tasks, so formalization of pending tasks and modelling of proper tools are necessary;
- IGD can solve the tasks (engineering metrics), which are not typical for classical graphics, so expanding the role of integration among other disciplines;
- The core of computer-aided graphical file (drawing) becomes not a view, but management of the object which is represented in a drawing to which insufficient attention has been paid so far;
- IGD element structure is unique, its intellectual level is limited and can not be very high, so even in information surrounding the essential role is taken on by a user.

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SPECYFIKA RYSUNKU GEOMETRYCZNEGO WE WSPÓŁCZESNEJ GRAFICE INŻYNIERSKIEJ

Metody stosowane do niedawna w nauczaniu komputerowej grafiki inżynierskiej nie wykorzystują całego potencjału jaki oferują nowoczesne programy, gdyż nauczanie to jest zazwyczaj oparte na przestarzałych metodach wizualizacji. Sformułowanie nowej koncepcji i nowoczesnej technologii bazuje na dwóch przesłankach: (1) wymagania projektowe i problematyka zadań w informatyce podlega procesowi rozwojowemu, a co za tym idzie metody tradycyjne stają się nieaktualne z uwagi na ich nieprzydatność w rozwiązywaniu praktycznych problemów, (2) możliwości i potencjał nowoczesnych programów kompu-terowych znacznie rozszerza możliwości projektowe. Dzisiaj można dokonać w sposób automatyczny i prawie natychmiastowy analizy produktu stworzonego w rzeczywistości wirtualnej środowiska komputerowego. Dodatkowe informacje na temat produktu znajdą się na wydruku. W konsekwencji otrzymujemy produkt graficzny z dołączoną do niego bazą danych informatycznych. W pracy opisano nowe podejście do grafiki komputerowej takie, iż podkreślono znaczenie niektórych tradycyjnych metod stosowanych w grafice inżynierskiej a także podkreślono rolę informatyzacji w rozwoju tych metod. Nowe podejście otrzymuje nową nazwę: Informatyczna Grafika Inżynierska (IEG). Model IEG z powodzeniem propagują wykładowcy w Wileńskim Uniwersytecie Technicznym im. Gedimina.