

# Mathematical foundations and principles in practice of computer aided design simulation

J. Sedivy , S. Hubalovsky,

**Abstract**—Today, programs for technical modeling are used in almost every field or industry. We see them in technical industries as well as in our everyday life and even in areas where we would never expect to see them. It generally replaces the creativity and imagination of the designer, and in many cases it helps determine collision situations and points during the creation of new products. As these programs recently became less expensive and therefore may be obtained more easily, computer graphic design is also being used in practical training, during regular classes as well as for the preparation of studying materials.

**Keywords**—Mathematical modeling, computer simulation, computer design.

## I. INTRODUCTION

Parametric models are made of a set of mathematical equations. Using a computer can design objects modeling their components with real behavior and attributes. In order parametric models have any validity, must be based on proven or using actual project data. Since there can be many variables of each type, the variables are generally represented by vectors. Typically, a specialist in mechanical design and building design, parametric modeler is aware of the properties of components and interactions between them. Parametric modeler software also provides a tabular view of the components and maintain their links with other model views.

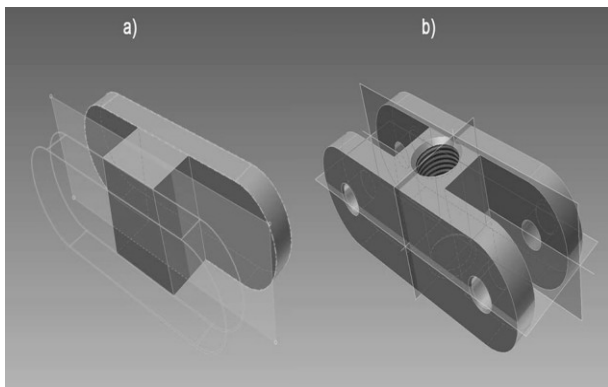


Fig.1 Principle of mirroring design element is to copy and a mathematical adjustment of vectors

As part of the edit graphically, this list is updated when a part is edited on the list are updated graphical views.

Computers and computer aided design programs became indispensable during technical classes. The core of each CAD (computer aided design) system is a parametric modeler. The current trend in the process of object design - and not only for the design of technical objects - is the application of the parametric modeling process, which provides a certain method of expression. Using advanced computer graphic technologies you may design difficult phases of the object, while displaying the object in real time. The efficiency of parametric modeling is based on its philosophy. For example, a description of a technical part with the help of technical parameters and mathematical expressions allows the designer to perform immediate modifications and then automatically project these modifications onto the assemblies, layouts, drawings or related production and control tools. This reduces production costs even at the design stage of the future product.

## II. THE MAIN RESEARCH PLAN

The main research plan for Department of Informatics Faculty of Science is system approach in computer Science. A systemic approach is one of the options, how to approach human thought. In this sense we are talking about systemic thinking. In systems thinking, or thinking through the system must be seen as one of the methods of thinking. As a result, it is a methodological approach to the problem of thinking.

Thinking means in a broader sense, the sum of all mental (psychiatric) activities in the narrower sense of their complex and probably the only man of his own, which processes and uses information. Thinking from individual perceptions and experiences progresses to the general terms and through the practical and theoretical management of the world of reality. This follows the sensory perception, memory and uses creativity, with its contents, however, treated more or less systematic and regular manner. Information about the surrounding world, the surrounding reality gained in the process of thinking through the senses - sight, hearing, touch, smell and taste. Unfortunately, our senses are limited to obtaining a very narrow range of information and this additional information is subjective and biased. Thinking can be represented as a process that transforms input to output. Objectify the information, organize it, and based on generalizing them to create images of reality (models), procedures and patterns of behavior (processes) provides a systematic approach, systematic thinking, or thinking of using

the systems. Systemic thinking is the process of understanding how things interact within the whole. In the history of the development of systems thinking went hand in hand with the growing volume of information and knowledge gained by studying reality. The basis of systems thinking is a concept system. With a bit of exaggeration we can say that the term system, we can understand anything - material objects and phenomena, ways to organize, abstract concepts, process going on, ways of solving problems, etc. The correct identification of the investigated system (defining the boundaries and limits of the system and its properties) allows an objective process information about the system, create generalizations and models of reality. With the system of concepts, systems thinking is related more terms - model and modeling. The purpose of modeling, the purpose of modeling is to describe the content, structure and behavior representing a real system, defined as a part of reality. The model is always only an approximation reality because real systems are usually more complex than the model itself. The notion of a model closely related to the simulation, which can be modeled using the system and its behavior represented in real time. Computers have become a phenomenon of the late 20th and 21 century. Without them, a process understanding of reality can not imagine. The process of cognition of reality had a new helper in the form of computer modeling, computer simulation and visualization. With some exaggeration, we can talk about "visualization" of reality. Systems thinking is the process of understanding how things influence one another within a whole. The systems approach integrates the analytic and the synthetic method, encompassing both holism and reductionism. In science systems, it is argued that the only way to fully understand why a problem or element occurs and persists is to understand the parts in relation to the whole. Partial plans of research of application of system approach in computer graphics are to find tools for:

- Support of logical thinking skills
- Support of technical thinking.
- Support of spatial imagination.

The partial conclusions of the research are the creation of ability to view graphics objects as a set of mathematical equations supports and to precise rule defining the process leading from mutable input data up to the required results and to analyze the problem of graphics models definition and finding the optimal practical solution. The essence of work in vector graphic programs is a vector representation in computer graphics: Vector graphics is one of two basic methods of representing the image information in computer graphics. While in raster graphics is the whole picture described by the values of individual color dots (pixels) arranged in a rectangular grid, vector image is composed of basic geometric shapes such as points, lines, polylines, and polygons.

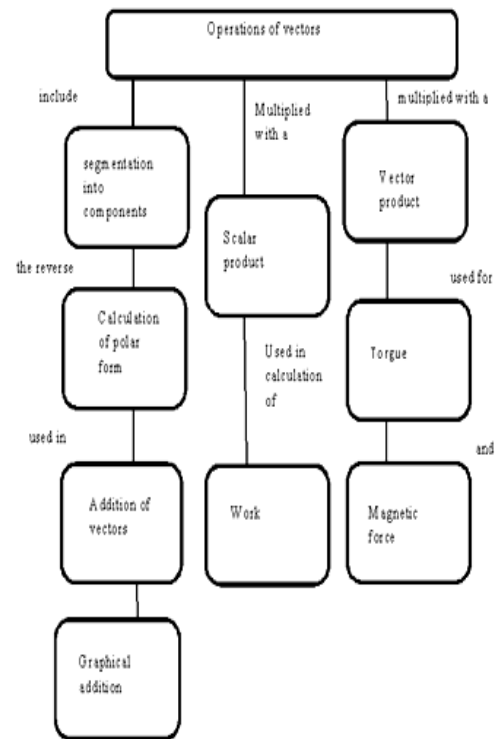


Fig. 2 Distribution of basic vector operations

### III. CURVES IN COMPUTER GRAPHICS

Although it may seem that the term "curve" is intuitively clear, it turned out that finding mathematically precise definition and also for what we understand intuitively under this term, is not easy. The beginning of curves and surfaces reaches deep into our previously associated with everyday human activities (building shelter, track moving the bodies, etc.). As also mentioned in the introduction, different disciplines approach the notion of curve in different ways (geometric topology, differential geometry in physics, computer graphics, etc.). The curves are divided into plane curve is described by continuous functions  $x, y: \langle a, b \rangle \rightarrow \mathbb{R}^2$  as set points  $p(t) = (x(t), y(t))$ , where the parameter  $t \in \langle a, b \rangle$ . Dimensional curve is described by three continuous functions  $x, y, z: \langle a, b \rangle \rightarrow \mathbb{R}^3$  as a set of points  $p(t) = (x(t), y(t), z(t))$ , where  $t \in \langle a, b \rangle$ . Implicit and explicit expression: In addition to parametric curves, there are also expressed by the curve given implicitly or explicitly. For explicit expressions of plane curves, the function of a given  $y = f(x)$ , which are defined on a common interval  $I$ , where they also have their continuous first derivative. The set of all points that lie in the space  $\mathbb{R}^3$  and which can be written in the form  $(x, f(x), g(x))$ , we call the curve defined explicitly.

Another type of cutting curves can be input by:

a) *curves of the analytical prescription* (its mathematical notation). The best assignment, whether it's any of the previously mentioned methods. In practice, however, usually do not find this entry, and we calculate the resulting analytical

prescription, with the curve we can continue to work.

b) *curves of the individual points.* According to the requirements of the assignment will usually solve interpolation or approximation curve (general algebraic polynomial method least squares, etc.). An example might be the course of temperature measurement.

c) *curves for modeling.* For these curves we entered the control points (or other features such as tangent). The main objective of these areas is to have appropriate properties for modeling and it is possible in a reasonable time to calculate. These curves are described as Bezier curves, B-spline curves or NURBS curves.

Curvature of the curve is one of the basic features that characterize each the curve. The curves are two types of curvature. The first curvature (flexion) usually denotes a concept of "curvature" curve indicates the size of the deviation from line at a given point  $p(t_0)$ . The curve will have a point in the greater curvature, the more around the examined point differs from the line.

#### IV. SURFACES IN COMPUTER GRAPHICS

Extension curves, we get to the areas, but have much in common with curves, especially in specific areas that enlargement curves (Bezier surface, NURBS surface, etc.). Analogously as curves, surfaces can be divided according to the statement equation:

- 1) *Explicit surface*  $z = f(x, y)$ , where  $x, y \in J$ .
- 2) *Implicit surfaces*  $F(x, y, z) = 0$
- 3) *Parametric surfaces*  $x = x(u, v)$ ,  $y = y(u, v)$ ,  $z = z(u, v)$  where the parameter  $u, v \in \langle a, b \rangle$ .

Similarly as in the expression of individual curves are different and have different advantages and disadvantages. The parametric expression is easy to get the items from the default expression in turn can easily test whether a point belongs to the area. In our case we focus on parametric surfaces that are in the computer most frequently used graphics. Areas can also be divided according to how they are specified:

- a) areas specified analytical prescription (as previously described types of expression).
- b) areas specified boundary curves
- c) specified area network points (Bezier surface, NURBS, etc.)
- d) kinematically generated surface (surface of revolution, surfaces created by folding motion).

Curvature of surfaces: In comparison with the curves of areas we distinguish several types of curvature than that was at the surface. This is because the selected point on the regular surface can pass through any number of curves. Each of curvature based on normal curvature. In a regular point for a particular area can be a tangent curve, passing through this point and tangent to the tangent, to determine the normal curvature of the curve at a particular point as the first curvature of the curve, multiplied by forming an angle normal to the main area and the normal to the curve. All curves examined through this point, touching the common tangents will have the same normal curvature.

#### V. MODELING OF SOLIDS: TOPOLOGICAL SPACES AND TOPOLOGICAL EQUIVALENCE

If we want to seriously address how it is possible to define and describe the body, we can hardly do without notions such as topological spaces, topological views and  $n$ -manifold in  $E^m$ . The concepts we introduce in this section. We note it is a quite extensive and demanding game of mathematics. We are therefore we have to settle for just the basic information and terminology that we will later to use. Topological space is a set  $X$  along with its system of subsets of  $\tau$ . System  $\tau$  must satisfy the following axioms: 1)  $\emptyset \in \tau$ ,  $X \in \tau$ , 2) intersection of a finite number set of  $\tau$  must be back in  $\tau$ , 3) union of any number of sets (and innumerable) of  $\tau$  is  $\tau$  again. The system sets  $\tau$  must be closed to the final intersection and the sum of any (even with the countless number of elements). The file is called  $\tau$  topology on  $X$ . The sets in  $\tau$  is called the open sets and their accessories  $X$  in closed sets. Topological space will be denoted by  $(X, \tau)$ . Subset  $U \subset X$  topological space  $(X, \tau)$  is called the surroundings  $p$  point, if There is an element  $O \in \tau$  such that  $p \in O$  and  $O \subset U$ .  $p$  neighborhood of the point will be denoted  $U(p)$ . View  $f$  topological space  $(X, \tau)$  into the topological.  $(X', \tau')$  is continuous if the image of every neighborhood of the point in  $p(X, \tau)$  is currently surrounding the point  $f(p)$  in  $(X', \tau')$ . If  $f$  is a bijection and  $f$  and  $f^{-1}$  are continuous maps, then called  $f$  homeomorphism. Two topological spaces are topologically equivalent if there homeomorphism between them. Homeomorphism is mutually unambiguous mapping between topological spaces that preserves the topological properties. In terms of topology of both spaces are therefore the same properties (they are the same). Homeomorphism is the definition of essential body (but it also has significance the definition of concepts such as curve or surface).

#### VI. APPLICATION OF PARAMETRIC MODELING

The Theoretical Basis of vector graphics with analytical geometry Image is composed of individual points, but curves - vectors. Curves connect the anchor points and Individual Can Be Defined fill (color space or color change). These lines are Bezier curves called. The French Mathematician Pierre Bezier developed and the method that makes it able describe the four points by any stretch of the curve. The curve is described by two extreme points (so-called anchor points) and two points determine that the shape of the curve (control points). A connector between the control point and the anchor point is tangent to the resulting curve. Both magnitude and direction and must be specified for a vector quantity, in contrast a scalar quantity and which can be quantified with just a number. Any number of vector quantities of the same type ( same units) can be combined the basic vector operations. The theoretical basis of vector graphics is analytic geometry. Image is composed of individual points, but curves - vectors. Curves connect the individual anchor points and can be defined fill (color space or color change). These lines are called Bezier curves. Modeling objects in computer graphics task of fundamental importance.

Working with bodies (Albeit a different technical meaning) is also a common feature of many CAD systems for engineering, construction, etc. The existence of three-dimensional model allows obtain any information on creating a geometric object. You can get information such as for any display object, including cuts. Such characteristics can be calculated such as volume, mass, center of gravity, moments of inertia and radii etc. Furthermore, three-dimensional model can be used for automated preparation of specifications for finite element calculations. Using three-dimensional model can also be considered for automated pattern recognition arising during modeling - geometric model can become the basis for CAD systems with certain elements intelligence. Modeling secure systems or bodies subsystems, which are called volume modelers (solid modeler). The issue of modeling elements (representation objects on the computer) and the corresponding implementation is a significant area modelers Computer Graphics, which developed in the independent sector. The beginnings of this development the fall in about the seventies of the twentieth century. It has since been achieved remarkable results, which are largely conditional boom systems CAD. However, no development in this area yet be considered completely closed. In this chapter we will deal with the issue of solid modeling in more detail. Of the known methods of modeling will focus primarily on two of them, at representation of solids with the surface (boundary representation) and the so-called constructive geometry objects (constructive solid geometry). Always we will also consider the solution issues raised by the need to perform calculations (display, boolean operations) these types of models. Even before we go into practical solutions to these problems, we have first address the question of what we consider to be solid. Interpose, it is clear. You know it But probably only intuitively. It is not enough for computer processing, because your computer has no intuition. Theoretical introduction to the reader seem somewhat uncomfortable. For proper understanding of it is at least some knowledge in this regard necessary.

#### VII. REAL APPLICATIONS OF SYSTEM APPROACH IN MATHEMATICAL PRINCIPLES OF COMPUTER GRAPHICS DEVELOPMENT

Science systems thinking attempts to illustrate that events are separated by distance and time and that small catalytic events can cause large changes in all complex systems. System approach is method which increase to attention and simultaneously, also motivation; method supports objectives of research. Parametric modelers may use different environments and user interfaces, but the general principles of parametric modeling are similar. The relevant software application is mostly used as another creative tool. Models are created through sketching and through volume or spatial constructional elements. They must be clearly defined, without any redundant or contradictory information. There are always

several solutions. Technician must be able to deal with difficult and demanding logical tasks and must be able to use spatial imagination. This offers many opportunities for the application of alternative teaching methods, problem and project teaching techniques and the development of creative teamwork [1].

The art of learning to solve problems lies in the fact that the student-technician acquires the ability to independently seek solutions and strategies and to make decisions in alternative situations. Information technologies offer many opportunities for the application of alternative teaching methods, such as the problem and project teaching techniques and the development of creative teamwork [2].

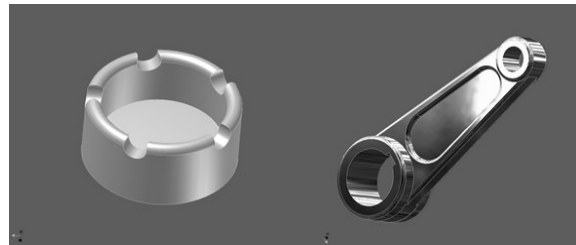


Fig.3 First step of system approach in modeling: free creation of the model

In order to strengthen cross-curricular relations, the Secondary School of Applied Cybernetics in Hradec Kralove introduced project teaching classes. One of the projects realized by the school is called the Virtual tour of objects. The technology of virtual reality is based on various fields such as programming, computer graphics, mathematics, but also on various artistic fields.

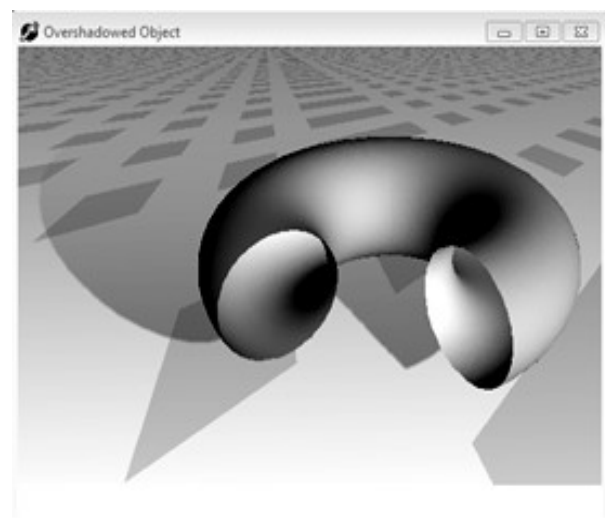


Fig.4 Next step of system approach: parametric modification of an object with realistic design and effect lighting

x(r,s)=		$\sin(r)(4+2\cos(s))$	
y(r,s)=		$\cos(r)(4+2\cos(s))$	
z(r,s)=		$2\sin(s)$	
Perspective	Scale	Parameters Limits	
Horizont angle	x =	r =	
Vertical angle	y =	s =	
Center Dist.			
Light Direct.			
Horizont angle		Right Color	Start
Vertical angle		Wrong Color	Exit
No of Segm.			

Fig.5 Table of parametric modification of an object with realistic design and effect lighting

Therefore, the above-mentioned project involves students focused on these fields of study. Students of the Computer Graphics class undergo classical art training and courses, which teach them the basics of computer graphic technology. Participants in the project are organized into two groups including future experts of various disciplines. Some are technically oriented (e.g. programmers) and others are artists. To achieve creative cooperation between these groups of students is not always an easy task.

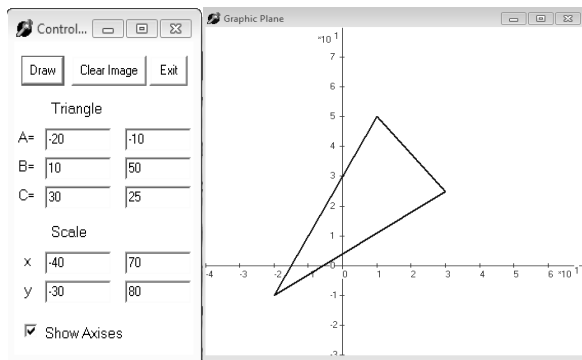


Fig.5 Own using of mathematical tools in creation of parametric mathematical models

Own creating simply mathematical tools are the last step in the understanding of the principles of the creation of graphical objects. Own work on the basis of the game with the objects created motivation: How software creates graphical objects?

### VIII. CURRENT CONCEPT AND STANDARD EXPLANATION TOOLS

The current prevailing and rather traditional concept of e-learning provided in virtual university projects is limited to discussions, research and to the evaluation of the LMS environment. Typical examples of the LMS in our universities are environments such as Moodle or WebCT. Today, e-learning is viewed as a rather simple remote administration tool for student projects, remote communication between teachers and course participants, or as a mechanism for

external expert supervision focusing on the professional level of individual courses [3]. Professional discussions are still focused on unclear results, while trying to demonstrate the benefits and disadvantages of off-line and on-line learning, in which each approach has its proponents and opponents, both on the student, tutor and course administrator sides. So far no unanimous agreement on what would offer the optimal solution has been found. The reason is not the helplessness or insufficient professional knowledge of people participating in these discussions. Variability of contents plays a role and the specialization of university courses in combination with the individual learning styles of participants in a specific environment of the virtual learning method. Currently, only some projects take into consideration the comprehensive view of digital learning offered by a virtual university, as a functional unit or as a model, which assumes a thorough system analysis of all solid, obvious and useful functionalities of the virtual university, which is necessary for successful implementation. Only very rarely do we find the concept of a modern educational institution as an integral unit combining the advantages of today's hi-tech technology with a common point of interpersonal communication, where personal relations and relationships between teachers and students are created and where valid and strong intergenerational experiences are shared as part of the educational process [4].

### IX. STRENGTHS AND WEAKNESSES OF THE TRADITIONAL AND THE TECHNOLOGICAL APPROACH

Virtual learning through the use of technologies should be viewed as a functional unit trying to achieve the greatest possible teaching effectiveness. Technological tools and company applications focusing on hardware and software come up with astonishing innovations every day, which may be used - with a certain degree of inventiveness, in the process of effective learning. Today a student may complete his or her tasks using a mobile phone, laptop or PDA, while taking a train to school or study and read the necessary literature using an electronic reader after downloading the text for free or through the use of commercial products.

Let us seek the maximum degree of analogy with the traditional university, where we not only analyze in detail, but intuitively feel the elements of traditional teaching as fundamentally beneficial. As an example, we would like to mention that during studies at the University of Technology, a group of students complied with a boring obligation to visit a not very important technical exhibition. At that time, a former assistant presented 2 international patents here. Since then the students not only kept their utmost respect for the teacher, but also formed a close relationship with the study subject. All of this because of the knowledge that this expert would share his skills, time and energy with the students [5]. Specific opportunities offered by communication technology may be further enhanced and thus we may take full advantage of the strength and the potential of digital communication. Therefore, connecting to and utilizing the strengths of traditional teaching

is a joint task of these experienced teachers, and at the same, it is a task for specifically focused teams of professionals dealing with information technology. This will enable us to achieve the necessary synergies with the common goal of these two professional groups, which still defend their preconceived attitudes to the digital communication of educational content with mutual disrespect. Training teachers to operate and administer some of the randomly selected LMS environments did not produce the expected results. Due to the overestimation of the power of information technology in the minds of people and due to the extent and complexity of this task, this article does not try to present a comprehensive analysis of virtual communication with primary educational goals - that is to present a complex model of a virtual university with all the links necessary for such a model [6].

#### X. IMPLEMENTATION OF MULTIMEDIA EXPLANATION SUPPORTS OF PARAMETRIC MODELING

The progress in information technology has been changing the forms and methods of education. Application of multimedia supporting elements has improved the quality of the educational process. For example graphical symbols representing sketch links or values of parametrical dimensions are relatively small and usually it is not possible to magnify them together with other entities on the desktop. Therefore, for a visual and schematic job description and to display individual details, it is necessary to record the picture in high definition. Due to the high bandwidth, the use of online technologies is limited by the speed of the relevant Internet connection. Today's lifestyle requires speed and clarity. From this point of view, various tools used during the education process which use clear and demonstrable samples are very useful and beneficial. That is why many software applications that use an interactive environment - and which work with real programs, are being developed (e.g. Microsoft Office – Word, Excel, PowerPoint, Access and others). Countless programs are used for this purpose. The main producer and developer of these applications is the well-known and recognized company Adobe (Adobe Systems Incorporated). Software produced by Adobe, such as Captivate, Director, Authorware, Robohelp etc. shares one common disadvantage. It is not free. Plus it is rather expensive, because it was mostly developed for companies. However, thanks to their valuable parameters and high quality, these programs are considered the best in the interactive multimedia education field. At the same time, there are also free programs/software available in the interactive multimedia education field. As an example, the most important free software is a program called Wink. All software offers format conversion as required by the final product. Applications produced by Adobe are able to create multimedia presentations but procedures and manuals I required use Flash, for animation, interactivity, and accompanying audio and video. Of course, the follow-up creation is a very time-consuming task for a person who also administers regular

classes at the university. Further, the larger the project is, the greater are the hardware requirements. This creates another financial burden for workplaces and classrooms that use these modern methods. The author must be able to process several types of activities at the same time, unlike with other common programs. During the creation of the presentation the author becomes the graphic designer, animator, film editor, etc. To follow this development and to be able to visit the number of training sessions and courses is an impossible task for a university professor. Preparation of presentations used in classes and preparation of multimedia applications usually involves several people or a work team. Thanks to integrated functional guide modules, a basic version of this method is available for the ordinary user as well [7]. There are many programs focusing on this topic. There are basic and well-known applications used for the creation of instructional presentations and webpage contents, such as non-commercial programs offering the user basic and quick tutorial messages (Microsoft Office PowerPoint, Publisher, Adobe Flash Professional, Replay Screencast, RoboDemo, CamStudio and many others). However, today's multimedia applications require a certain degree of professionalism and specialization. Samples of applications used for the creation of interactive multimedia presentations, which the teacher should be familiar with are: Wink, Camtasia Studio, Adobe Director, Adobe Authorware, Adobe RoboHelp, Adobe Captivate.

#### XI. SIMPLE AND EFFICIENT SAMPLE, DEMONSTRATING THE CREATION OF MULTIMEDIA SUPPORTING ELEMENTS

Not all tools require professional knowledge. An example of a very efficient environment used for the creation of multimedia supporting elements without the need for extensive professional knowledge is the software Captivate. The web page of Digitalmedia server (a part of the Adobe server), describes the use of the Captivate software. Only three learning stages should be sufficient and the user should be able to create highly efficient instructional presentations or simulations in the Captivate program. Captivate automatically records all actions you perform on the screen. High speed computer networks enable continuous high definition video streams between the source and the end user. Another alternative is video transfer using a "video on demand" system. Digital technology also enables reproduction of audiovisual recordings stored on optical disk recorded by a computer, TV or player. As we see, the applications of these technologies are very broad-ranging. For example, transfer of a picture/image of a multimedia disc (usually ISO format) between the client and FTP server is also possible, which is very useful for example for distance learning students [8].

Audiovisual recording may be done with a video camera, and with other necessary technical devices. An alternative solution is the application of a system used to record meetings or to make them accessible, for example Sonic Foundry Mediasite. However, this system is more suited to recording

meetings during which a computer presents static images only. Recording meetings with animations or video sequences or performances that contain a demonstration of computer software, it is better to use other technologies. The important issue is to select the correct lighting intensity of the person doing the presentation in order to achieve high quality recording, but at the same time, this light may negatively affect the recording of the visual presentation happening at the same time. However, for the visual description of work done in a parametrical modeler, the recording quality of the person doing the presentation is not as important as the recording of the computer desktop. Usually, every move of the mouse cursor is crucial. Uncertain or jerky motion of the mouse cursor or searching through drop-down menus during the presentation is confusing for students [9]. The same is true for the use of shortcut keys, which cannot be seen on the computer desktop. Only a few systems used to record the computer desktop enable the user to visually display activated sections of the keyboard or mouse. The majority of parametrical modelers enable the user to work efficiently with shortcut keys; however, during a presentation I consider the use of shortcuts inappropriate. The situation may change when we begin to use multimedia teaching materials. In order to implement and use multimedia teaching, it is not important whether this process involves integrated multimedia or individual tools/aids in different formats which enable the user to present the relevant information. The important issue is that these tools activate more of the students' senses simultaneously. Multimedia materials are elements of the so-called educational process supported by technology (technology-based training), which provide information, teaching/education materials and educational content through different forms of electronic media; therefore they are part of e-learning. Detailed results of the research are available in a book called *Alternative technologies used for the creation of multimedia teaching supports*.

Adobe Captivate is a potential tool for the creation of interactive multimedia educational methods and for simulations of the functionality and control of various software applications. While working with a parametrical modeler, the image of the computer desktop is recorded as well as actions and events occurring due to the use of the keyboard or mouse. Then, using the editing mode, the user may add to the picture of the recorded desktop voice commentaries, text descriptions, raster images in various formats, audiovisual sequences in AVI format (audio video interleave), simple vector graphics, presentations in Microsoft PowerPoint or possibly other interactive elements (e.g. press buttons, links, etc.). The finished work may be stored as a self-executable file (Windows executable), Microsoft AVI or in a format supported by Macromedia Flash (SWF, FLA, FLV). These may be shared via web interface or FTP server (file transfer protocol). The advantage of this option is that the user needs only a minimal knowledge of computer graphics, multimedia and video programming. The desktop of a computer may be

recorded using other software tools as well (e.g. TechSmith SnagIt, Hyperionics HyperCam Technology LLC, etc.) and compressed visual sequences in Microsoft AVI format created without needing large available storage on your hard drive. Audio commentaries may be stored individually or simultaneously. The quality of the audio recording is based on the quality of the sound card and the external microphone. The workplace where the audio recording is done should be well prepared for acoustic recording because background noises negatively affect the recording quality and may destroy the entire work. The picture and audio recordings may be synchronized by using tools for processing audiovisual materials such as programs belonging to the software suites Adobe Premiere, Sony Vegas or Canopus Edius. You may also use multiple audio and video tracks and perform various editing operations. For example you may change the speed of the playback of individual sections, or apply various transition effects or filters, insert subtitles, etc. The structure of the future optical media, time axis, playlists, chapters, multi-language subtitles, graphical design etc. may be created with the applications mentioned above or using other sophisticated tools such as Adobe Encore or Sony DVD architect. To compress the final recording it is necessary to use easily available codecs, for example a codec from the MPEG group (motion pictures experts group).

## XII. CONCLUSION

As the literature says, human beings have huge creative audiovisual thinking abilities and when they think, they use visual images rather than words. So-called visual thinking is mostly used in abstract fields. The perception of visual information represents the largest share of the entire perception done through all our senses. Visual presentation catches the attention, awakens interest and helps with conceptualization. Presentation together with practical demonstration is much more effective. Many terms and thoughts may be understood through visual methods rather than through verbal methods only, for example, practical skills. They should serve to help to expand the visual image. Therefore, it is necessary to keep in mind during the creation of a multimedia teaching educational application to add voice commentaries only to information that is not clear from the presentation itself. Regardless of the applied technology, it is clear that the creation of multimedia teaching supporting elements, and not only in connection with parametrical modeling, may be done by one person/teacher only and therefore it deserves a bigger share of our attention. This article was created under the project called *Specific research done at UHK Hradec Králové (2012)*.

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**Josef Sedivy** was born in 1963 in Czech Republic. He obtained master degree in education of physics and technical teaching science in 1987 and computer science in 2002 on University of Hradec Kralove. Doctor degree in theory of technical education in 2008 both in on University of Hradec Kralove, Faculty of Education, Czech Republic. He works as assistant professor on University of Hradec Kralove. His scientific activities are statistics tools for modeling and simulation

**Stepan Hubalovsky** was born in 1970 in Czech Republic. He obtained master degree in education of mathematics, physics and computer science in 1995 and doctor degree in theory of education in physics in 1998 both in Faculty of Mathematics and Physics, Charles university in Prague, Czech Republic. He works as assistant professor on University of Hradec Kralove His scientific activities are system approach, modeling and simulation.