Modern 3D Modelling, Visualization and Animation at Power Electrical Engineering Study Programme

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***Summary*: There is a tendency to enable a higher education for much more students in comparison with recent times. This, of course, concerns also technical universities. This aim calls for principally new modern methods of education, including creativity, invention and demonstration methods. One of the possibilities is to provide lectures with presentation of up to date computer aided design methods and their use in 3D technical documents preparation. The main goal for implementation of both new CAD packages and contemporary forms of technical documentation is to contribute to an independent creative ability of bachelor students. This paper has been presented at the conference SME 2006, Cracow, Poland.**

Key words:
CAD, model, electrical engineering, technical documentation, rendering, animation, computer support, EPD, PDM, CPM, TPP

1. INTRODUCTION

This paper will provide an introduction to the most commonly used applications at electrotechnical practice for building computerized 3D model of some technical details (at the master's programmes of technical faculty). These programmes are used for teaching 3D representation at the Faculty of Electrical Engineering and Communication: AutoCAD R2006, Mechanical Desktop 2006, Autodesk Inventor 10, 3ds max 7.

2. ELECTRONICS PRODUCT DEFINITION

At the BUT Faculty of Electrical Engineering and Communication, a Power Engineering and Heavy-Current Electrical Engineering study programme has been accredited that educates students for engineering jobs in designing, production planning, and development and control of technological processes. It is in these areas that the improved quality of a new approach to product design and production planning is becoming apparent by replacing CAD/CAM solutions being by a comprehensive solution. EPD — Electronic Product Definition systems allowing electronic definitions of products beginning with its design and ending with its manufacture and PDM — Product Data Management systems are gaining importance. Mass application of such systems will create an environment where all the paper 2D documents will vanish to be replaced by 3D models. All the data generated are used as electronic definitions with immediate access guaranteed.

With the existing system of representation using the method of perpendicular projection onto one to six planes of projection, referred to as a 2D system, which is still in use in all our companies, students have to have good imagination (even for quite simple parts), however, this imagination has not been trained during their previous education. Determining the dimensions (dimensio-ning) of a product part, which a student can hardly imagine, is rather difficult. This is perhaps one of the main reasons (another one may be the ignorance of production technologies and the options they offer) why students view such subjects, and the study fields where they are taught, as difficult to master. This is true not only in the Czech Republic, but judging from the information available, also in other countries. The result is then lack of not only managers and developers, but also designers. The aim is, therefore, to use 3D representation in teaching as much as possible with all its benefits.

In the field of technical preparation of production cannot be solved in industrial practice by partial efforts, or by more frequent use of "uncompact" computer supports. Solution lies only in system change, which we can see these days in the developed countries, meaning the use of complex computer support known as Electronics Product Definition — EPD — together with a system of all product data administration — Product Data Management — PDM — including the connection of company economics and Manufacturing Execution Systems trade — MES. Sharing and exchange of information exists not only at company level, but also between individual institutions — Collaborative Production Management — CPM. Use of these systems creates the situation when 2D paper drawings at design and development of individual components, especially of sets, nearly disappear and shall be replaced by 3D models of high effectiveness. In the final stage, there are two variants, depending on technical equipment for production. The better variant is when the completed 3D model is sent to the control computer of e.g. machining or forming centres. In other variant, conversion of a 3D model to a classical 2D drawing is presupposed and then its transfer into production. All the originated data are electronic definitions, which are immediately accessible. The system maintains all the information related to technical preparation of production, including the files and database items.

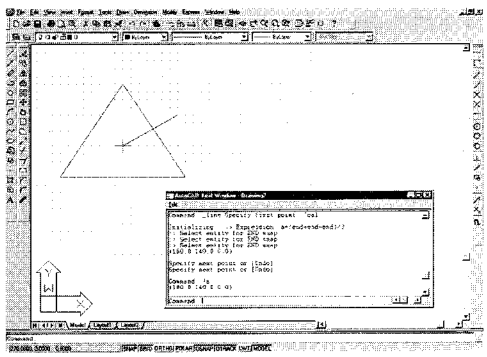


Fig. 1. Geometric calculator

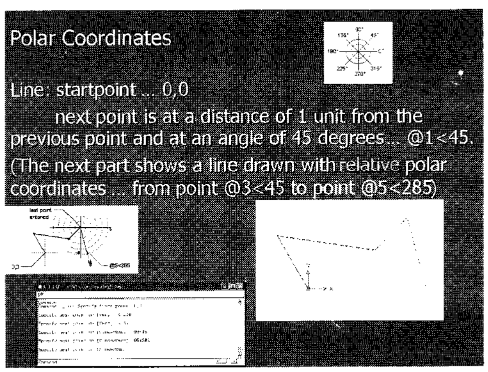


Fig.2. Using coordinates

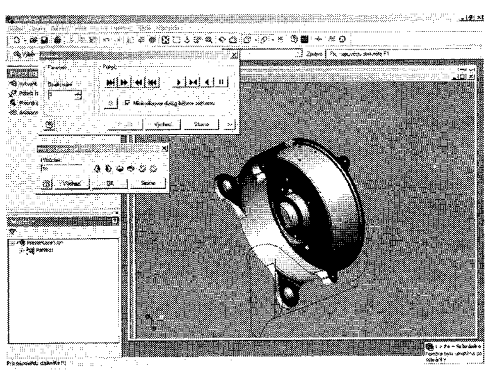


Fig.3. 3D model — one of the steps from animation at Autodesk Inventor

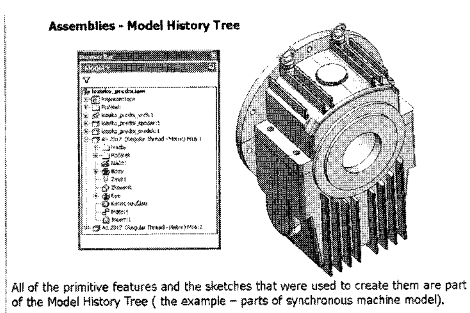


Fig. 4. The Model History Tree

If the prevailing activity of the bachelor's programme graduate specialized in Heavy Current Electrical Engineering and Electrical Power Engineering should consist of work with up-to-date technology, then it is absolutely necessary so that he would be able, among others, not just to read safely and without errors the technical documentation in a 2D form, but also to work with the documentation in a 3D form.

It is obvious that the classical CAD systems in the form in which they are taught and applied at most of the technical faculties (not just in the disciplines related to TPP) are perhaps sufficient for the present situation in most enterprises in the Czech Republic but definitely they will not be sufficient for coming future. Use of classical procedures and methods in TPP will be in a short time quite insufficient for quality and fast innovations of competitive products. If we want our economy to be at least at European level, it necessarily has to undergo — with respect to certain rigidity in thinking of elder technical workers - probably a painful system change in TPP.

3. THE EXAMPLES FROM E-LEARNING

3.1. AutoCAD

Geometric calculator — CAL command — allows:

- Calculate a vector from two points, the length of a vector, a normal vector (perpendicular to the XY plane), or a point on a line.
- Calculate a distance, radius, or angle.
- Specify a point with the pointing device.
- Specify the last-specified point or intersection.
- Use object snaps as variables in an expression.
- Convert points between a UCS and the WCS.
- Filter the X, Y, and Z components of a vector.
- Rotate a point around an axis.

3.2. Autodesk Inventor (Fig. 3)

Assemblies — How the Model History Tree Works:

Inventor keeps track of the steps that are taken to create a solid — sketches, extrusion, revolution. These are recorded in the Model History Tree in the lower left corner of the screen — Figure 4.

Autodesk Inventor displays different visual clues, or symbols, to show you alignments, perpen-dicularities, tangencies, etc. These constraints are used to capture the design intent by creating constraints where they are recognized – Figure 6. As the sketch is made, Autodesk Inventor automatically applies some of the geometric constraints to the sketched geometry. There is possible continue to modify the geometry, apply additional constraints, and or define the size of the existing geometry.

3.3. 3ds max (Fig. 7)

Parametric Environment is presented on Figure 8.

3.4. Analysis of the magnetic field

The calculation of the magnetic stray flux was done using analytical method with considering the space of the magnetic flux. Further this problem is solved using the Finite Elements Method. Results of the bouts solutions are compared and presented. Further there is shown the possibility of using this method by the design of a machine and the results are presented on concrete examples. Magnetic field in the rotor is shown in Figure 10 (FEM — analysis).

3.5. Modelling

Basic of 3D Modelling is presented on Figure 11.

4. CONCLUSION

There is necessary to prepare many tutorial examples with application of 2D and 3D modeling to principal parts of electric machines and apparatus. These tutorials would demonstrate advantages of the new implemented system. The other example models have to be also available for individual study.

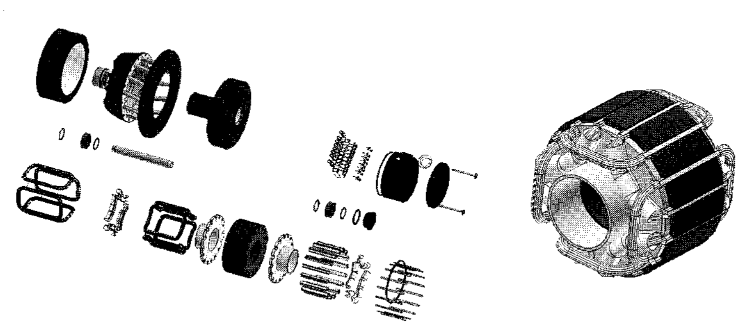
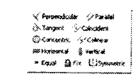


Fig. 5. Autodesk Inventor — model of one-phase asynchronous motor with external rotor



For instance:

Vertical	Represents a line is vertical
Tangent	Represents the cursor is at tangency points to curves
Horizontal	Represents a line is horizontal
Parallel	Represents a line is parallel to other entities
Perpendicular	Represents a line is perpendicular to other entities

Fig. 6. Constraints

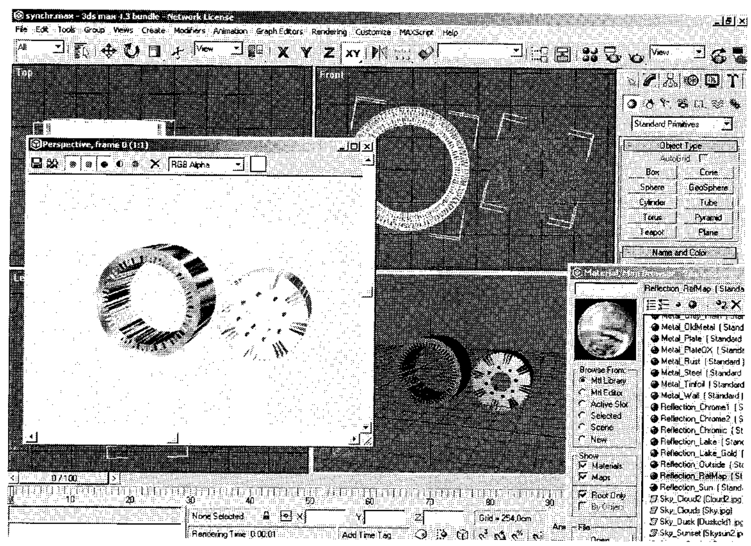


Fig. 7. 3D solid model of synchronous motor with smooth-core rotor — 3ds max

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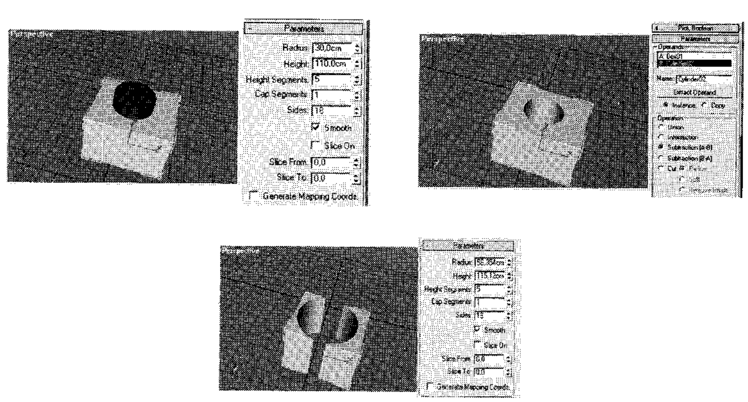


Fig. 8. 3D model and Boolean function and the result at parametric environment

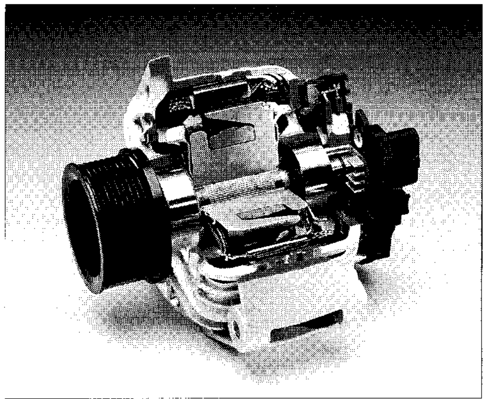


Fig. 9. Automotive alternator

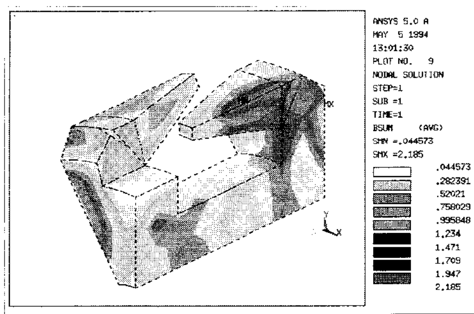


Fig.10. The rotor magnetic field of the automotive alternator

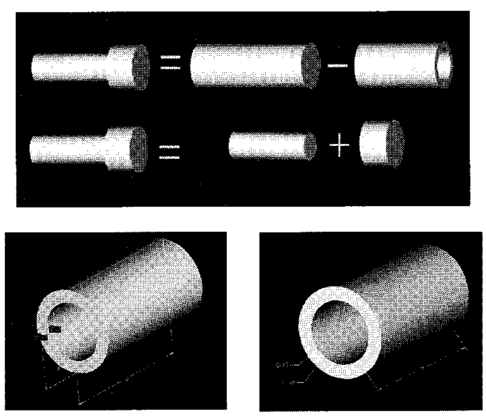
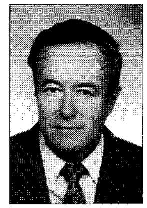


Fig. 11. The creation of 3D model — dissimilar practice, identical result



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