COMPUTER – AIDED GRAPHICS IN DESIGNING OTOLARYNGOLOGY (ENT) INSTRUMENTS

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ABSTRACT

The paper presents some aspects related to the application of assisted graphics in medical engineering, specifically in the design of medical instruments for ENT diseases. The stages of making a three-dimensional part otoscope along with the Autodesk Inventor design package capabilities of obtaining 3D models and related 2D documentation are also presented.

KEYWORDS: medical engineering, parametrized modeling, Autodesk

1. INTRODUCTION

The software application **Autodesk® Inventor®** enables engineers to go beyond the 3D design phase and easily move on to the next level of Digital Prototyping by using a new and complete set of instruments intended for the 3D mechanical design which facilitates design, view and simulation of products before their physical construction. Inventor Professional includes all the basic functionalities for 3D design, productivity and communication of Autodesk Inventor application, plus expanded capabilities for creating objects of manufacturing plastic, systems design and optimization of complex routes and performance validation of digital projects. The application helps to minimize the need for testing the project, the physical prototype and the production costs. For media kits up to 1,000 pieces, Autodesk Inventor can be installed on Microsoft ® Windows 7 (32-bit or 64-bit) Home Premium, Professional, Ultimate or Enterprise Edition, or Microsoft ® Windows Vista ® (32-bit or 64-bit) Home Basic, Home Premium, Business, Enterprise, or Ultimate Edition (SP2) or Microsoft ® Windows XP Professional (SP3) or Professional x64 Edition (SP2) (1.2), while for large ensembles we recommend only 64-bit versions. The system requirements for working with media kits to 1,000 pieces are:

- Intel® Pentium® 4, 2 GHz or faster, Intel® Xeon®, Intel® Core™, AMD Athlon™ 64, or AMD Opteron™ processor, or later (3)
- 2 GB RAM or more (4)
- Microsoft® Direct3D 10® or Direct3D 9® capable graphics card (5)
- DVD-ROM drive (6)
- Microsoft® Mouse-compliant pointing device
- 1,280 x 1,024 or higher screen resolution
- Internet connection for web downloads and Subscription Aware access
- Adobe Flash Player 10 (7)
- Microsoft® Internet Explorer® 6.x through 8
- Microsoft® Excel 2003 through 2010 for iFeatures, iParts, iAssemblies, thread customization, and spreadsheet-driven designs
- Microsoft .Net Framework 4.0

After launching the application, the new interface meets the current tendency to have a well structured ribbon at the top of the screen. Controls are grouped into several ergonomic access categories as follows: Model, Inspection, Tools, Manage, View, Environments, Get Started, Sketch. In the category "Draw" the following drawing commands/controls are included : Line, Circle, Arc, Rectangle, splines, ellipses, Point, Fillet, Polygon, Text and Geometry Project As shown in Figure 1.
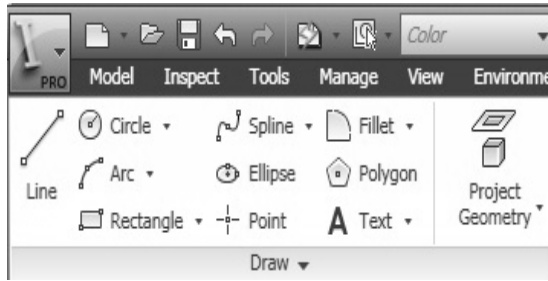
Fig. 1 Drawing controls

The ribbon futher includes a section of dimensional and geometric constraints of the type: fixed point, coaxial point, horizontal, vertical, symmetric, tangential, parallel perpendicularity, etc.. All these restrictions are shown in Figure 2.
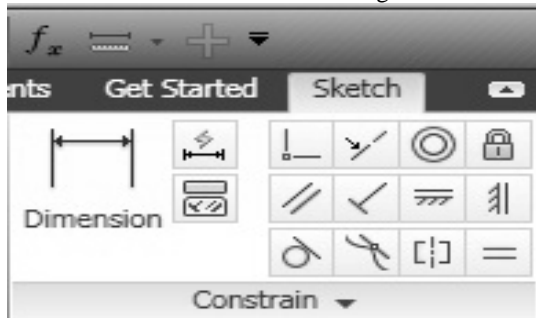

Fig. 2 Dimensional and geometric constraints

Pattern multiple controls such such as Rectangular, Circular, Mirror are grouped in the section "Pattern" and the modification controls are: Move, Coppy, Rotate, Trim, Extend, Split, Scale, Stretch, Offset in the "Modify" As shown in Figure 3.
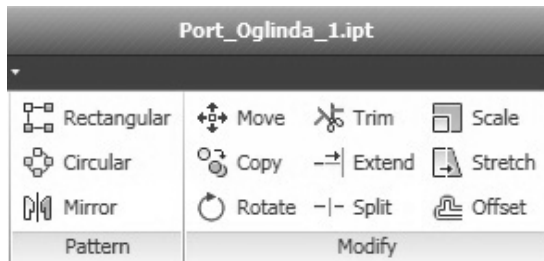
Fig. 3 Drawing modification controls

Looking from left to right, the ribbon also contains four more sections namely: Layout, Insert, Format and Exit which are illustrated in Figure 4.
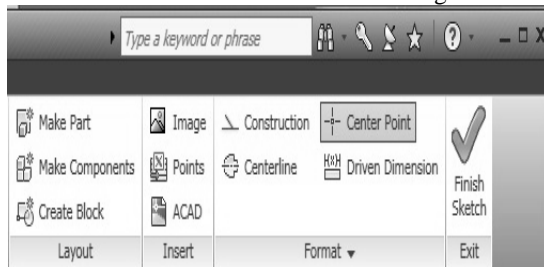

Fig. 4 Last four sections of the Schetch ribbon

2. METHOD OF GENERATING 3D MODELS AND SUBASSEMBLIES

Once the program is launched, the user can select by clicking on the button "New" the type of file that he wants to achieve: Part, Sheet Metal, Standard.dwg, Standard.iam, Standard.idw, Standard.idw, Standard.ipt, and Weldmet.iam. Once the selection is made in the window shown in Figure 5, the program interface is defined in accordance with the stated purpose.
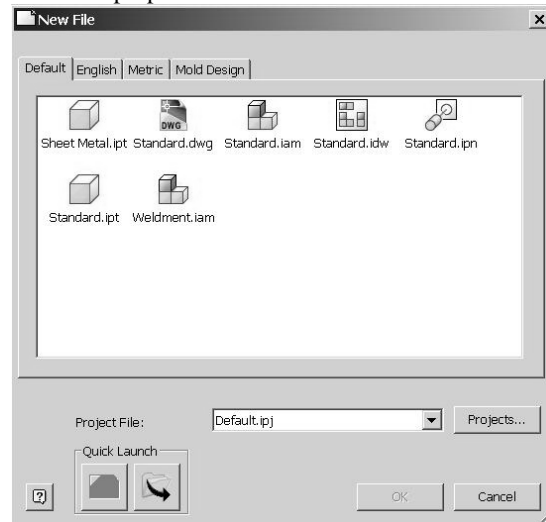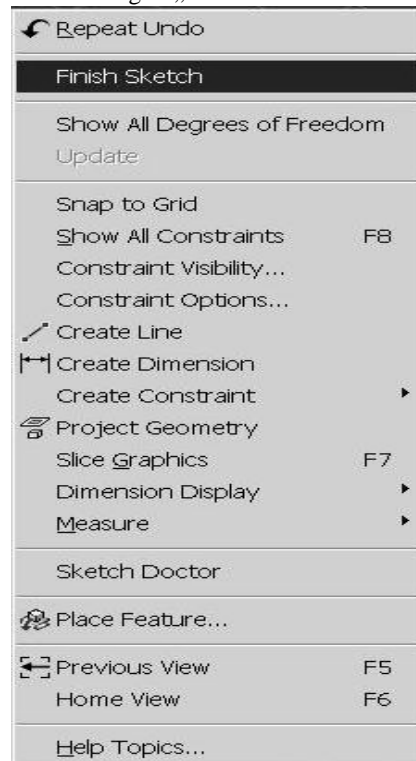

Fig. 5 „New" window

Fig. 6 Menu run on with the right mouse button in drawing a sketch stage

Modeling begins by defining a parametric sketch which, after the approval for completion, may pass to the second phase, i.e. generation of the three-dimensional model. This is possible either by clicking the "Finish Sketch" at the top right of the related ribbon, either the right mouse button as shown in Figure 6. Before completion of each sketch, it is compulsory to define the dimensional and geometric constraints. An example of geometric and dimensional constraints is shown in Figure 8.
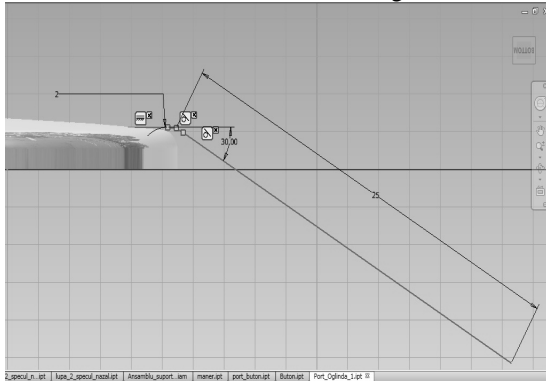

Fig. 7 Example of geometric and dimensional constraints

After completing the sketch, there are activated the controls for generating the three-dimensional bodies such as Extrude, Revolve, Loft, Rib, etc. Each of these commands is characterized by a window defining the geometric modeling parameters. For example, Figure 9 illustrates a window that defines the parameters of Extrude command.
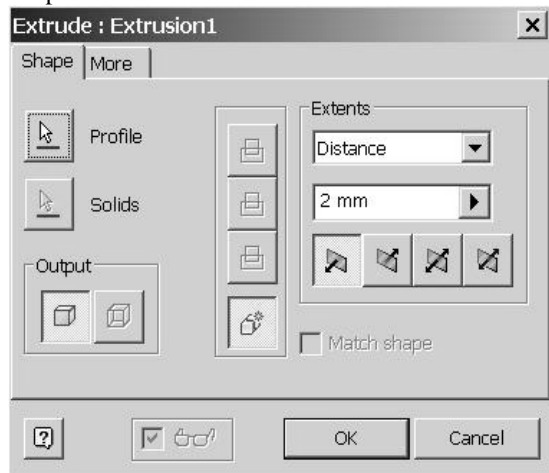

Fig. 8 Extrude command defining window

All 3D parts are saved separately and then they will form sub-assemblies or assemblies of different complexities. It should be noted that to generate the desired sub-assemblies or assemblies, the specific file type with extension *.iam Assembly should be opened in which it shold be inserted the desired three-dimensional models one by one. With the insertion, 3D contraints must be imposed so as to block the degrees of freedom of the parts in the newly formed complexes. The box introducing 3D constraints, as shown in Figure 9, is relatively complicated, being

characterized by four labels: Assembly, Motion, Transitional, Constraint Set, each with its own parameters to be set according to the assembly to be made.
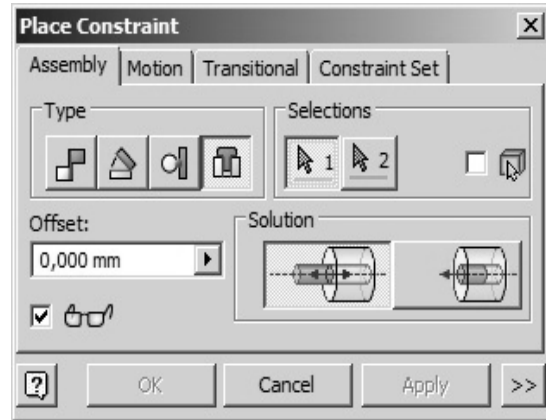

Fig. 9   3D contraints window

3. RESULTS

To facilitate the way of defining the proposed assembly, the work was initially focused on geometrically constrained subsets and the assembly was finally generated. This method allowed easier selection of the elements that need to be constrained. Thus, in Figures 10 and 11 are three subassemblies/subsets that form the final assembly illustrated in Figure 12.
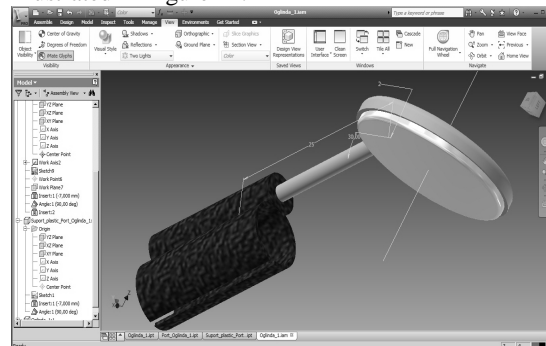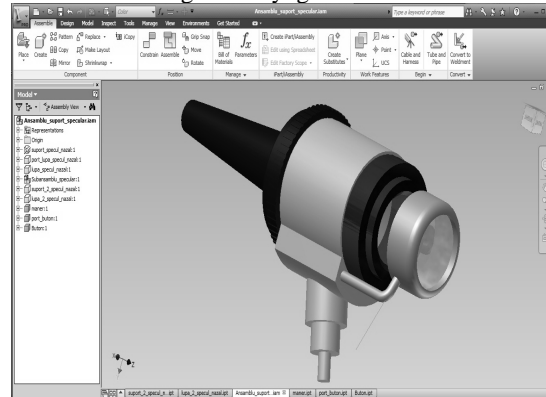

Fig. 10 Laryngeal mirror

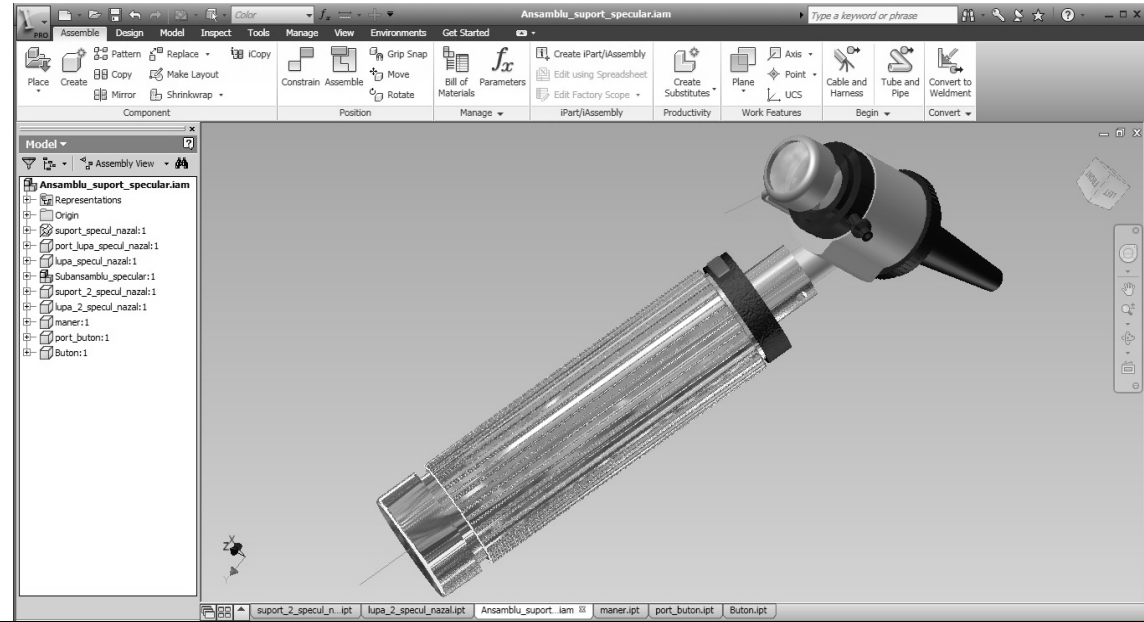

Fig. 11 Subassembly - ear spectrum

Fig. 12 3D assembly of an otoscopic

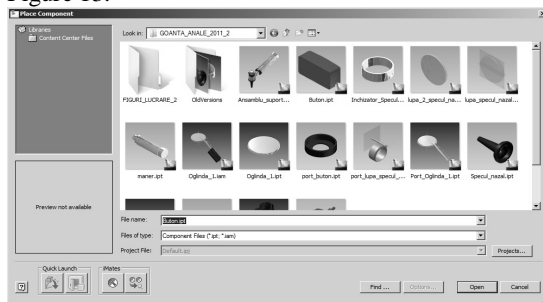Adding each item can be done by the command "Place Component" whose window is shown in Figure 13.

Fig. 13 Place Component window

For a more realistic view of each marker and of the whole assembly, there can be attached various textured materials that make the material look more real.
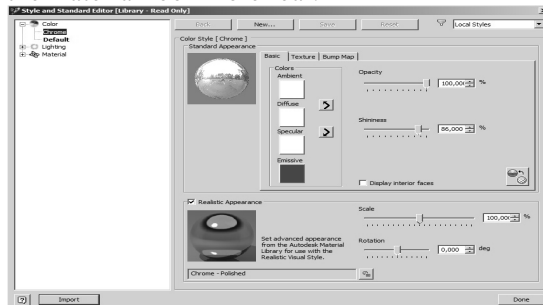

Fig. 14 Materials editor window

There is a predefined library of about 180 materials which may be changed in terms of adding new material of variable aspects. This is achievable by using materials whose editor window is shown in figure 14.

4. CONCLUSIONS

Autodesk Inventor implements the advantages of Autodesk Digital Prototyping solution, giving designers the possibility of reusing the existing DWG designs in a 3D modeling environment. Inventor enables users to read and write in native DWG files without the risk of distortion or loss of information due to a translation process and the possibility of creating 3D models from 2D AutoCAD DWG files. Inventor also includes applications able to create and document 3D projects, and also offers interoperability with competing applications from the mechanical industry, thus simplifying collaboration with other providers or beneficiaries. The Autodesk ® Inventor ® 2011 software product line redefines the term "Ease-of-Use" with a new revolutionary design challenge that provides a number of significant benefits to engineers who have to design, view and simulate products.

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