

ACTUAL PERFORMANCE 3D RESTRICTIONS OF INVENTOR 2015

Abstract: *The work ranges between papers that leave detailed documentation based on the analysis of current performance 3D constraints, the Autodesk Inventor 2015 and draws a number of conclusions in general about this latest software. Basically, the author, after a presentation of the current situation and trends and future aided design, makes an analysis of how 3D constraint of the three-dimensional assemblies. Also some of the innovations introduced by this version are highlighted.*

Key words: *Design, CAD, modelling, 3D constraints, Autodesk Inventor.*

1. INTRODUCTION

At this moment in design workshops, working in different ways, depending on the specific tradition and planned financial resources available. Small businesses mechanical design use various versions of traditional *AutoCAD*, while the category of medium-sized firms, but with substantial financial resources, have switched to more efficient platforms such as *Inventor*, *Solid Edge*, *SolidWorks*, etc. In parallel with these, big design companies use software of the integrated category, such as *CATIA*, *NX Siemens PLM*, *PTC PLM* that contain multiple modules, in which: the design, 3D modelling, analysis finite element simulation of production and not least documentation management throughout the lifecycle of the product. Regardless of the performance platform design, all the 3D design versions of the software market, allow 3D modelling of medium or high complexity assemblies, which can be obtained orthogonal or axonometric projections, including the bill of materials and masses of all components.

Considering all these aspects mentioned above, more and more economic agents of mechanical sector in Romania, believes that 3D design is a priority for the creation and development of more efficient products, as long as you do not lose years engineering experience and expertise gained in designing the so-called classical or 2D after 1990. *Computer Aided Design (CAD)* in its initial form of 2D, which in the early 1990s revolutionizes the design, has become something classic nowadays, which has been replaced by 3D design during the time.

This 3D design at a global level, involves the use of constraints relative of positioning of all parts that are inserted in the file, parameterized type. This new stage in the evolution aided design, is no longer limited to computer-aided drawing, followed by quotation, hatching and eventually completing the parts for assembly drawings, but is distinguished by adding new features and tools three-dimensional modelling of complex geometry, which can automatically get orthogonal projections and axonometric. The designer has only the concern of conception rates and technical specifications. Competition increasingly fierce between firms design / manufacturing determine an increased dynamicity market

for the appearance of new design solutions that have the ability to generate 3D models that respect the physical and mechanical properties of materials, which were attached by the designer. At the same time, producing companies of equipment and machines, as a result of the competitive environment [1] in which it operates, take into consideration all the changes both in terms of technology, design and manufacturing process technology. Shorten the cycle of product development is a requirement for any company located in a permanent competitive fighting, and it can be optimized by integrating the design process at the factory, due to the development of an intensive information flow between the design and the fabrication. It can be said that at any time, we find the simultaneous existence of both companies with classical process design, 2D, and firms with modern 3D design process, some highly evolved forms such as those based the software [2] *PLM - Product Lifecycle Management*.

2. ENFORCING RESTRICTIONS 3D FROM AUTODESK INVENTOR 2015

Inventor 2015 brought to the designers, new superior means of 3D design, both at the piece and at a global level [3]. In parallel with this, it is continued with the traditional principles of direct manipulation, which help accelerating the design with indirect effect on improving creativity.

Due to direct manipulation, all needed data for a command (rays, angles, quotas, etc.) is viewed and controlled simultaneously, no longer needed those classic drop down dialog boxes. In essence it is about the almost complete elimination of the use of dialog boxes because all settings, options and data modelling can be made directly on the graph for modelling space. Additionally, ordering generating or editing 3D show in advance change trend.

The beginning of any assembly starts with the presentation showed in Figure 1, which communicates to the software, that the first part, which will be introduced in the new assembly is a component of "ground". This setting will take effect that the first brought piece as a whole, will act as fixed element (base, frame, casing,

motherboard, etc.) over which will sit next, based on 3D restrictions.

When inserting any component with the command *Place* as results from Figure 2, appear in the graphical area several active buttons, handling (*Y Rotate 900 Rotate 900, Rotate Z 900, OK, etc.*) of which the designer chooses the one he wants, without having to enter the traditional windows command.

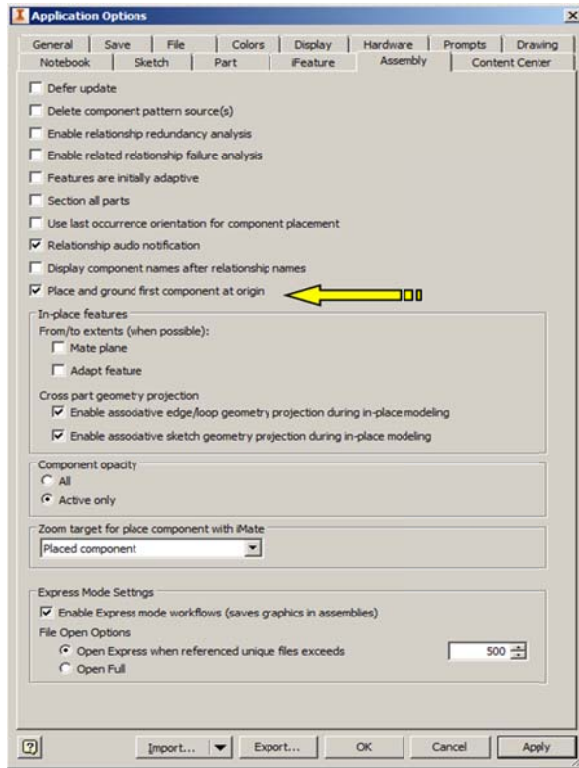


Fig. 1 Set for fixing the first component

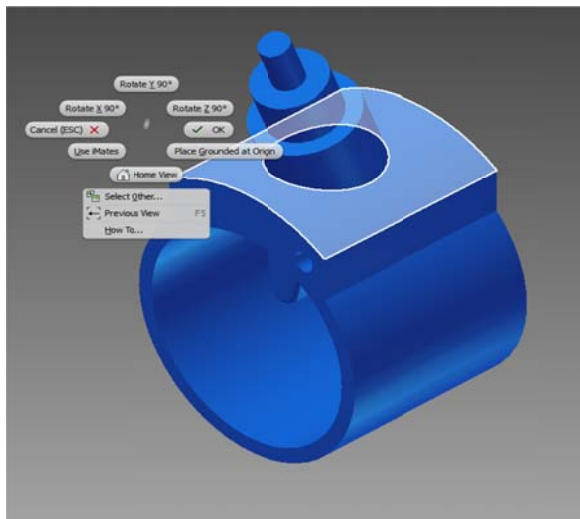


Fig. 2 Buttons active handling

For bringing other components in contact, *Inventor* designer provides three distinct variants namely: *Assemble relationship* type, type couplings *Joints* and *Constraints* type restrictions.

2.1 Assemble Relationship type

Inventor users can now "engage" *Assemble* components using the new tool. This new tool will automatically seek to engage one of the existing piece on the screen with new track, which is inserted and moved on the screen. This tool displays a mini toolbar that shows different looks depending on the selected options at a time. Also along with the type couplings *Joints*, leads to the elimination of degrees of freedom without cluttering your browser of the left screen, with many restrictions. Relation Type *Assembly* is an option that includes a lot of intelligence, reason is backed up by the concept of *Inference*, which is defined as an logic operation which admits that a certain judgment is true if it is inferred through a chain of true judgments.

2.2 Joints type couplings

Launching *Joints* type restriction is made as in Fig. 3, which is the specular subassembly [4], a medical instruments EAT Each of these ways of bringing in contact neighbouring parts, removes step by step degrees of freedom, finally letting free some of them, only moving parts. All these removed degrees of freedom, appear in the left browser window modelling, and as long as there are more pieces with more removed freedom degrees, the browser gets so busy and difficult to interpret. The advantage of using where necessary, linkage type restrictions in place *Constraints* are, consists precisely in reducing the number of components on relationships between parts of the browser. It should be noted that these couplings are more complex to simple and direct contact between the two surfaces of neighbouring parts. As results from Figure 4 *Inventor* simulates these types of couplings: *Rigid*, *Rotation*, *Slider*, *Cylindrical*, and *Ball* planar or very suggestive that have names. This type coupling *Rigid*, reinforces two components, one located near the other, *Rotationally* coupled permitted only rotation around an axis, other rotations and translations are blocked, *Slider* ensure dragging, *Planar* ensure permanent contact of a component on a flat surface, in while *Ball* restricts a spherical component in a hole, also spherical.

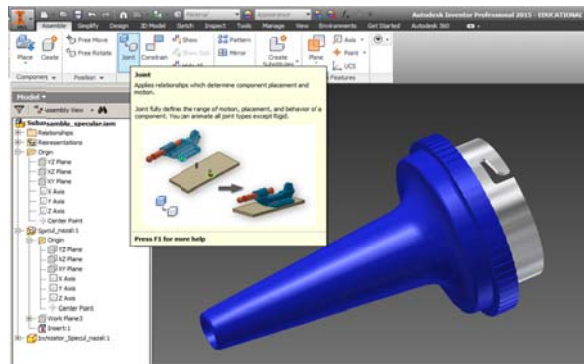


Fig. 3 Launch Joint command

In addition to the six types of couplers, there is the *Automatic* version, which includes all others.

The window that opens contains some very useful buttons, namely: connect buttons Connector Type Flip







equipped with the corresponding   , GAP distance type, sequence alignment and alignment button reversal    and not least the name shoe made.



Fig. 4 Settings window type couplers Joints

2.3 Constraints restriction type

Constraints type restriction is launched from the right type of joint and contains variants, which correspond to the contact options type parts *Mate*, *Angle*, *Tangent*, *Insert* and *Symmetry*, which are shown in Figure 5. Restriction *Mate* is used to align two pieces, by selecting two surfaces or two axes and presents two solutions for implementing, one type of application *Flush*, when the pieces are on the same side of the selected plane / line and *Mate* solution when pieces are on both sides of the selected item. Application *Mate* constraint leads to blockage of three of the six freedom degrees possible, exactly two rotations and one translation. In other words, the two solutions of constraint *Mate* are defined by the normals meanings to the selected surfaces, meaning that when they are opposite, we have the *Mate* version of the *Mate* constraint, and if we have the same meanings of the normals, we have the *Flush* version, *Mate* restrictions. In other words, the *Flush* solution means the bringing at the same level, of the two areas selected.

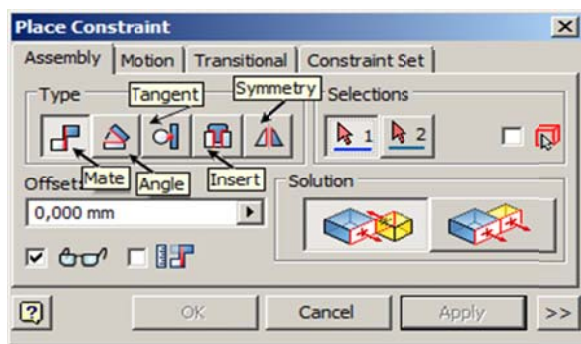


Fig. 5 Place Constraint window and type setting *Mate*

Restriction *Angle* allows the placement of the two parts, which were imposed for this restriction to a certain angle measured between two surfaces, edges or axes of the parts. In general, this restriction is not recommended to be placed before others, because sometimes it blocks a degree of freedom, while in other situations, it blocks two degrees of freedom. Related Settings window of this

situation is shown in Figure 6 and contains the following three types of application: angle directly and indirectly angle explicit reference vector. Version directly or oriented angle is measured after the right-hand rule, which depends on the order of selection of the two surfaces and the surface normals of the two selected.

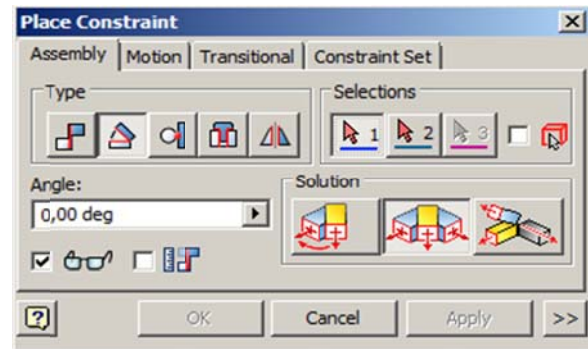


Fig. 6 Angle constraint window

To avoid some mistakes, it is recommended to apply a trick, which consists of two components manually rotate at an angle close to the one that is intended to be the final *Predict Offset and Orientation* check box, followed by rewriting the value found at the desired value. I have to mention that the numerical value of the window and *Angle* may have a negative sign. Angle indirect or undirected version does not require the application artifice above, it does not depend on the order of selection of surfaces, and in some cases it does not require to change the sign of the numerical value enter into, in the *Angle* box. The latest application, the one with explicit reference vector, is based on the definition of the vector space Z axis.

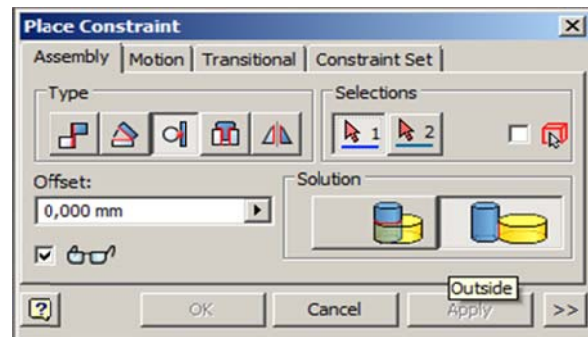


Fig. 7 Tangent constraint window

Restriction *Tangent*, whose setting window is shown in Figure 7 can bring in position two tangent interior or exterior surfaces of which at least one is a curved surface. In Figure 7 is set externally tangent type variant *Outside*. These restrictions can be applied at both surfaces bounded, and on their extensions.

Restriction *Insert* whose setting window is shown in Figure 8 can be inserted into holes homologous cylindrical bodies, imposing entrance depth is reported as the distance between two flat surfaces. The best example in which it can be used this restriction, is the case of introducing a screw passing through a hole.

In the first step, the restriction requires the indication of the common axis, and in the second step, it requires the distance between the flat surface of the body Drill flat surface, corresponding to the screw collar. This distance is applied either to arrangements of normals in opposite directions or in the same direction. For the case of introducing the screw-hole is recommended to select the second version, namely *Aligned*.

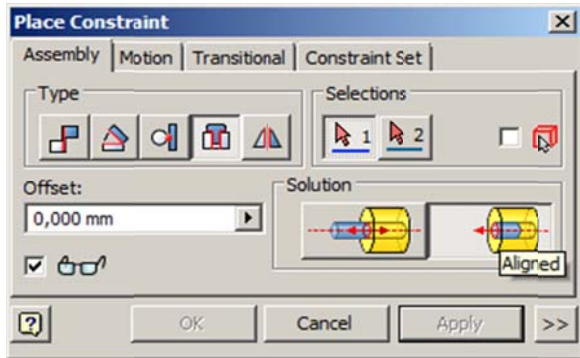


Fig. 8 Insert constraint window

Restriction *Symmetry* allows the imposition of a relationship between two geometry symmetry in a plane of symmetry. It should be noted that to apply this restriction, it should be created in an earlier time plane of symmetry, or it must be from an earlier stage. The window provides the designer a choice that the selected faces have normals in opposition or in the same direction.

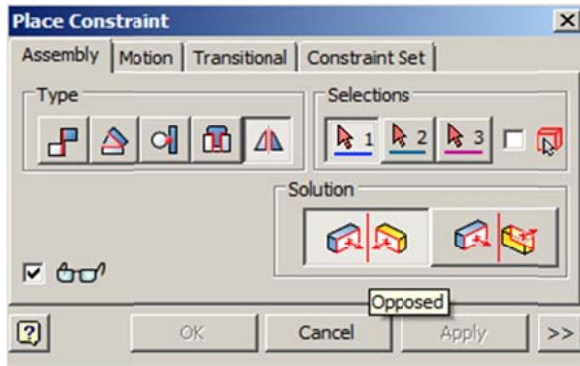


Fig. 9 Symmetry constraint window

3. CONCLUSIONS

Autodesk Inventor 2015 offers many significant improvements in the working environment to users, of which I mention:

- The introduction of the program since its opening, a centralized management interface files, called *Dashboard My Home*, which creates a tab at the bottom called *My Home*.
- Traditional drawing format, IDW type is replaced with DWG.
- Better management of updates and service packs by using *Autodesk Application Manager*.
- The possibility of permanent deletion of the parameters unused in box, called *Parameters* dialog.
- Introduction to *Sketch* command module *Look At*, allowing rotation of the selected plane with a minimum angle necessary X axis orientation in vertical or horizontal position.
- *Coincidence* constraint type is automatically associated.
- *Trim* command was modified so that multiple entities can be selected, and submitted to the order, simultaneously with a drawn *freehand curve*.
- The constraints which will be respected after finalizing the drawing are shown even during the time of drawing an entity.
- Introduction to the sketch of how *Relax*, that at its activation, allows changing geometry, without deleting the existing constraints.

The only disadvantages of this version are minimal hardware resources, which are quite demanding, as they announce the *Autodesk* namely: 32-bit *Microsoft Windows 7* (SP1), Intel® Pentium® 4 or AMD Athlon™ 64, 3 GHz or faster or Intel® or AMD dual core 2 GHz, 8 GB RAM for less than 500 part assemblies, *Microsoft® Direct3D 10®* capable graphics card or higher.

4. REFERENCES

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