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THE ORIGINAL SOFTWARE SUPPORTING DESIGN OF GEARS IN SIEMENS NX ENVIRONMENT

Abstract: The study presents a description of the original software supporting gears design. The discussed software is destined to make 3D models of spur and helical gears in Siemens NX environment. It is characterized by higher involute profile gear tooth accuracy. The main benefit of the original software is primarily reducing modelling time of gears up to a few seconds. It is also possible to create models using an individual parameters (including non-standard modules of the gear). The software was programmed using C# programming language and SNAP it is Simple NX Application Programming.

1. Introduction

One of the fundamental machine or device components is gearbox. Gearboxes are used in the small precision clockworks as well as industrial machinery or aircraft. Particularly important in industry are high power gearboxes. Warn-out gearbox replacement is linked not only to bear costs for buying a new one but also to lengthy production process interval. That is the reason why gearboxes have to qualify requirements of reliability.

Contemporary trend in mechanical engineering is tendency for reducing manufacturing costs. It means material saving, simplifying a technology, design form optimization. Taking the above facts into account it can be concluded that designer should find compromise between reliability requirements and economic and technical aspects. Design supporting software can be helpful in design process of gears. This software allows to create precise 3D models according to given parameters. This solution enables to omit frequently appearing errors and reduce time for element modeling. Using advanced CAD (Computer Aided Design) systems like Siemens NX one can perform gears analysis without wasting time for repeated modeling. For example Finite Element Method (FEM) – numerical technique for finding solutions for the differential equations that describe, or approximately describe a wide variety of physical (and non-physical) relations. FEM is the basic tool which occurs in many CAD environments like Siemens NX, CATIA, Solid Edge.

Gears generator is enable in Solid Edge and also Siemens NX system contains similar plugin. Moreover a tooth profile created due to above mentioned software is a curve (spline) probably based on the three points. It is the minimal sum of points needed to sketch a curve. Taking into account above the model accuracy might appear low.

To make sure that generated model has features relating to the high mapping of the tooth's cooperating part geometry the original software was created.

2. Gears generator

The software was programmed using C# programming language and SNAP it is .NET library. The first one was used for creating a graphic user interface (Fig.1).

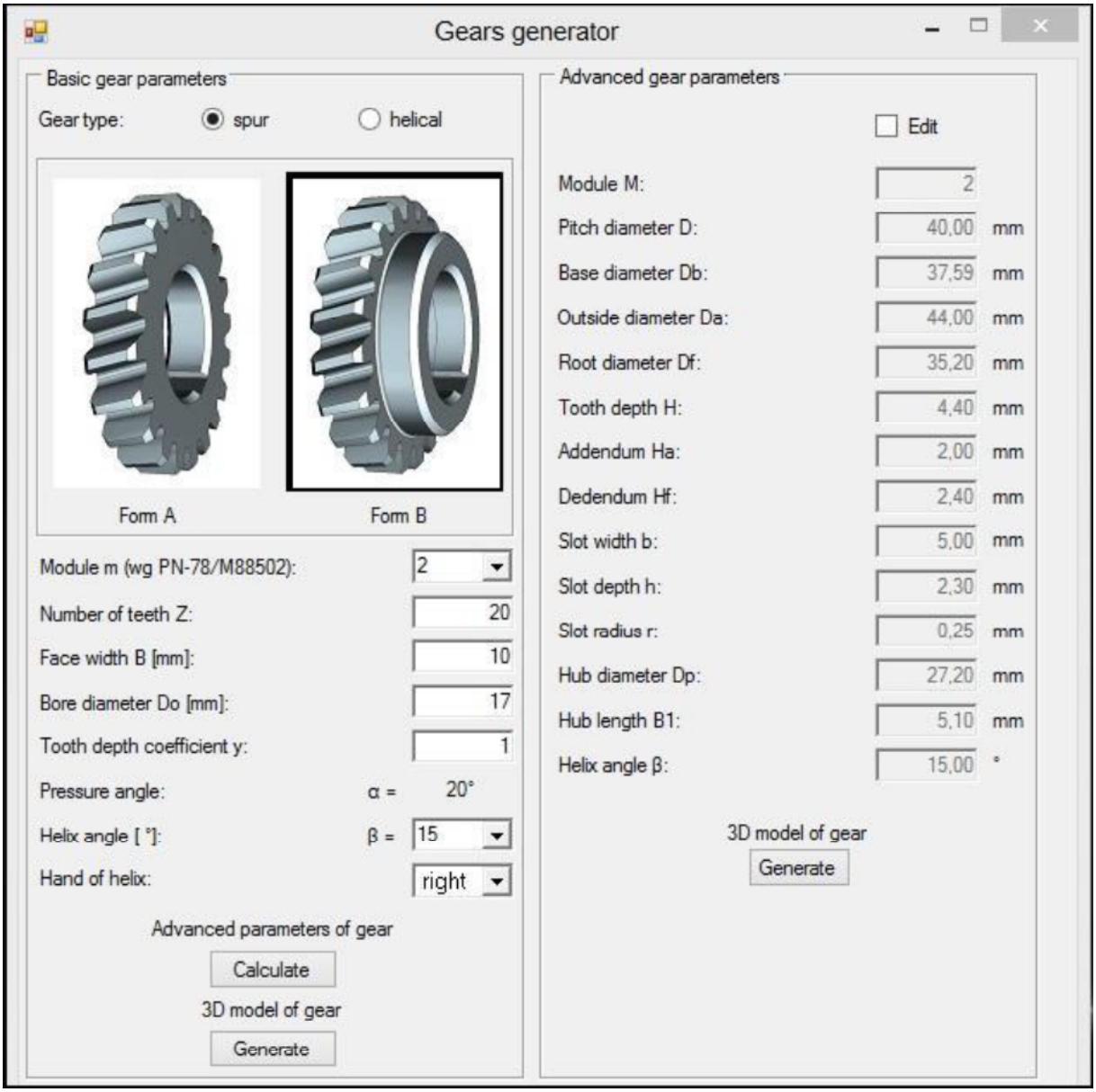


Fig.1. User interface

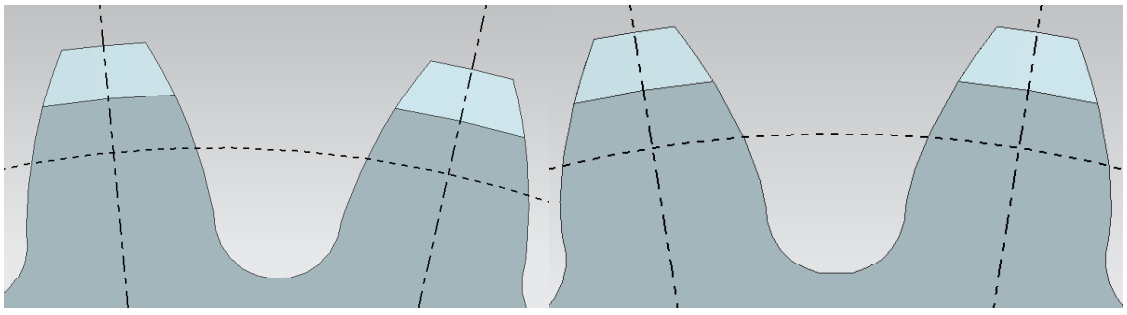
The second one (SNAP) was used in conjunction with C# to create 3D model. Combination of these two elements has been edited and compiled in an Integrated Development Environment (IDE) it is in Microsoft Visual Studio.

In order to generate 3D model of gears it is necessary to choose basic parameters of the gear. After completing all needed parameters it is possible to calculate advanced parameters of the gear or just to generate 3D model in Siemens NX (Fig. 2).

Fig.2. The example of the 3D model of gear: m = 2, z = 15, y = 1

Very important aspect is a possibilityto edit the advanced parameters. It means that using GEARS GENERATOR, it is possible to generate special gears with the individual parameters.

Involute gear tooth profile generated in the original software has been based on the 11 points. The same gear tooth profile based on 3 points is not as precise as the first one (Fig. 3).



a) *b)*

Fig.3. Automatically generated involute gear tooth profile: a) based on 3 pts, b) based on 11 pts

These differences are more evident with comparison of involute curves as the fig. 4 shows. The difference in the point of extreme reaches about 0.1 mm.

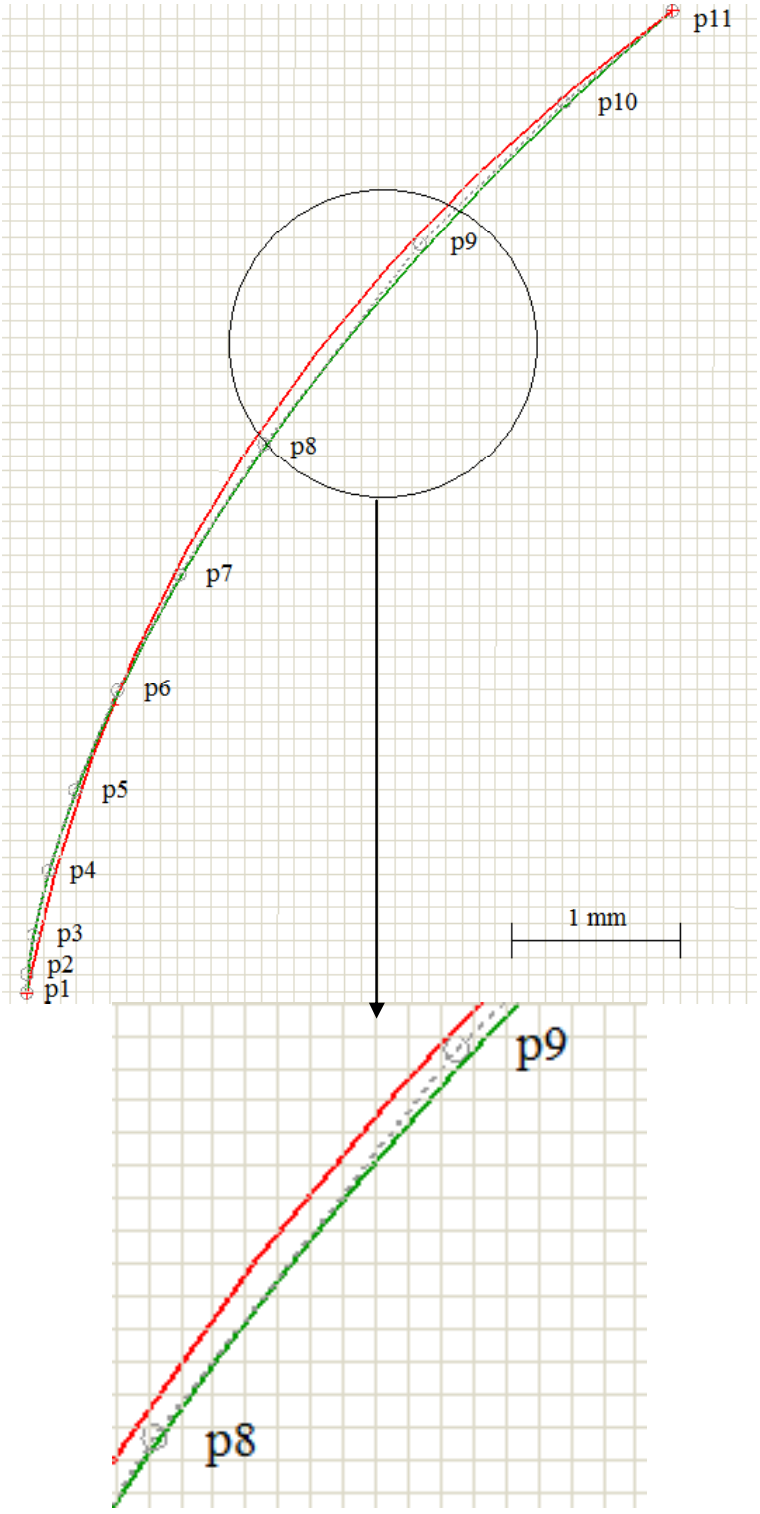


Fig.4. Involute curves: the red line – based on 3 pts, the green line – based on 11 pts

For a more detailed analysis of these teeth profiles the finite element method was used. For this purpose Design Simulation module of Siemens NX was used. During the numerical

simulation for the one particular tooth flank normal force of 500 N was applied (perpendicular to the surface at each point). The following results were presented in Fig. 5 and Fig 6.

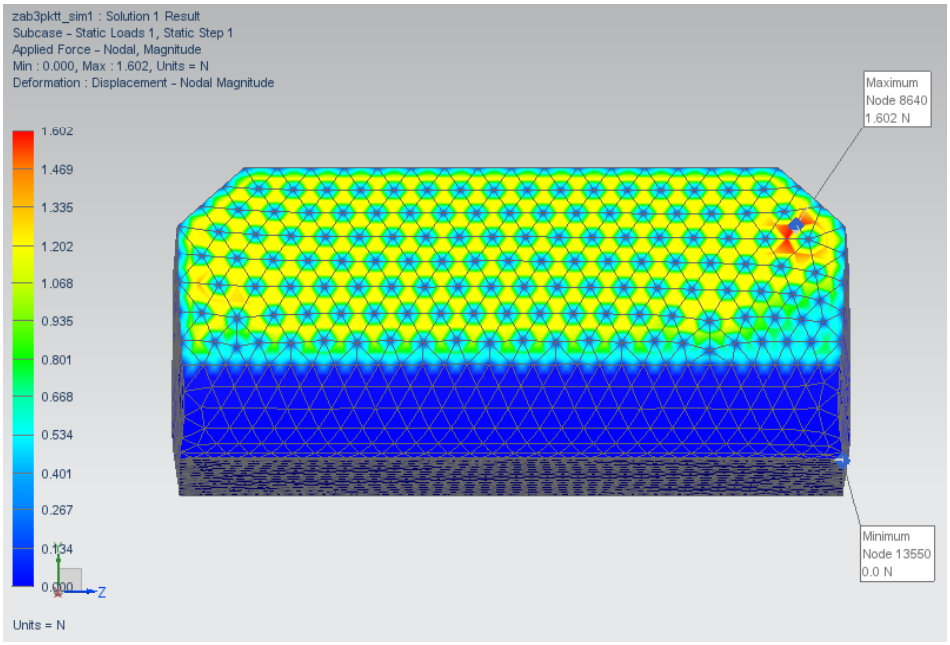


Fig.5. Analysis of force distribution for 3 pts

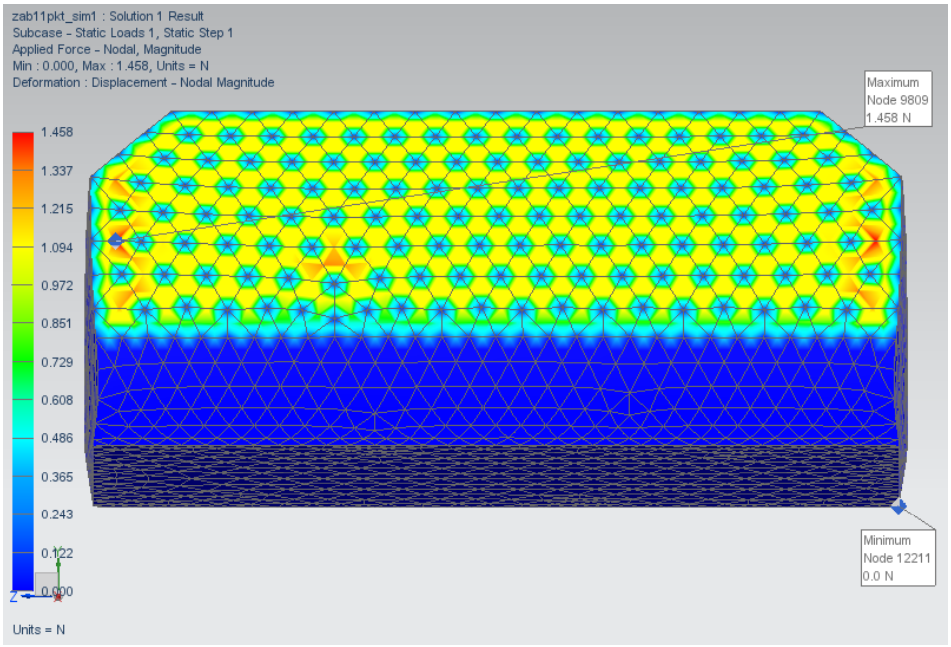


Fig.6. Analysis of force distribution for 11 pts

In case of the 3 pts tooth profile the maximum force acting on the node equals to 1.602 N.

In case of the second tooth is about 0.144 N smaller and amounts to 1.458 N. For less accurate tooth there is an asymmetric forces distribution (Fig. 5). The tooth profile based on

a larger number of points has a relatively symmetrical forces distribution on both sides of the engaging surface (Fig. 6). This phenomenon can also has positive influence on the fatigue strength of the gear.

3. Conclusion

Based on FEM analysis the inaccuracy models of gears with involute tooth profile based on three points was stated. These differences in results between the two outlines were small but in key situations the quality of the outline can make a big difference in case when high accuracy is required. 3D models generated in the NX environment using the original software can serve as a basis for analysis for gears certainly.

References

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