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THE REAL TOOTHING EDGES ON SHARPENING TOOTHING KNIVES

Ioan PANTEA, Mircea VEREŞ, Nicolae CRECAN, Anamaria MADURA
Universitatea din Oradea

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Abstract: Using a mathematical model that has as its study base the spatial gearing method of research, that is particularized for the technological gear formed at the rectification of toothing knives arranged in a circular arc pattern, calculus programs for optimizing the technology were drawn up in the programming environments of Visual C++ and MathCAD 2001. The chipping edge of the knife is in theory a line. The deviations of the chipping edge of the knife from a line that passes through the extreme points of the edge are determined through simulation. These deviations are evaluated in different sections of the resharpening domain of the knife.

1. INTRODUCTION

Profiling knives used for toothing conical gears with curved teeth is difficult if the knives are not properly executed; after a small number of resharpenings profile aberrations appear, aberrations that negatively influence the flanks of the processed teeth. The relieving technology utilized by the firms that manufacture machine-tools and tools for toothing conical gears with curved teeth is unavailable. In our country attempts of profiling toothing knives through relieving were abandoned because after a small number of resharpenings the knife's profile does not continue to correspond to the imposed conditions. The large number of toothing machines existent in the country entails the identification of more economically viable and precise methods of relieving knives that equip the gear cutting ends. Assembling rectification devices on the cross-side rest of the lathe is difficult because of the large number of knives on the technological head and the confined space between them. The abrasive wheel, while processing a knife of the technological head, touches the adjacent knives therefore special heads should be used, implicitly increasing the production costs. The numeric research from the present paper uses an algorithm resulted from the geometric modeling of the technology of rectifying the profile of knives used for toothing conical gears with curved teeth through the particularization of the conical gear research method of spatial gearing

If in the case of processing gears with curved teeth arranged in a circular arc there is the possibility of rectifying the gear's flanks, in the case of processing conical gears with teeth arranged in an epicycloid arc, there is none. The purpose of this numeric research is to determine the deviations of the rectified positioning surface of the knives used for toothing conical gears with curved teeth.

The calculus programs are applied for the exterior toothing knives that have a straight chipping edge. The 5 mm module knives that equip the toothing machines Hardac-Gleason type 6'' were chosen. They are situated at the middle of the dimension range and are the most frequent utilized.

The finish rectification is accomplished through rectification with an abrasive conical wheel on the axes of the Niles type worm cutter-rectifying machine or on the thread rectifying machines.

In order to attain the data presentation functions of the chipping edge’s coordinates, of the abrasive tool’s coordinates, of the deviations of the chipping edge from a line that passes through its extreme points and in order to display the diagram containing these

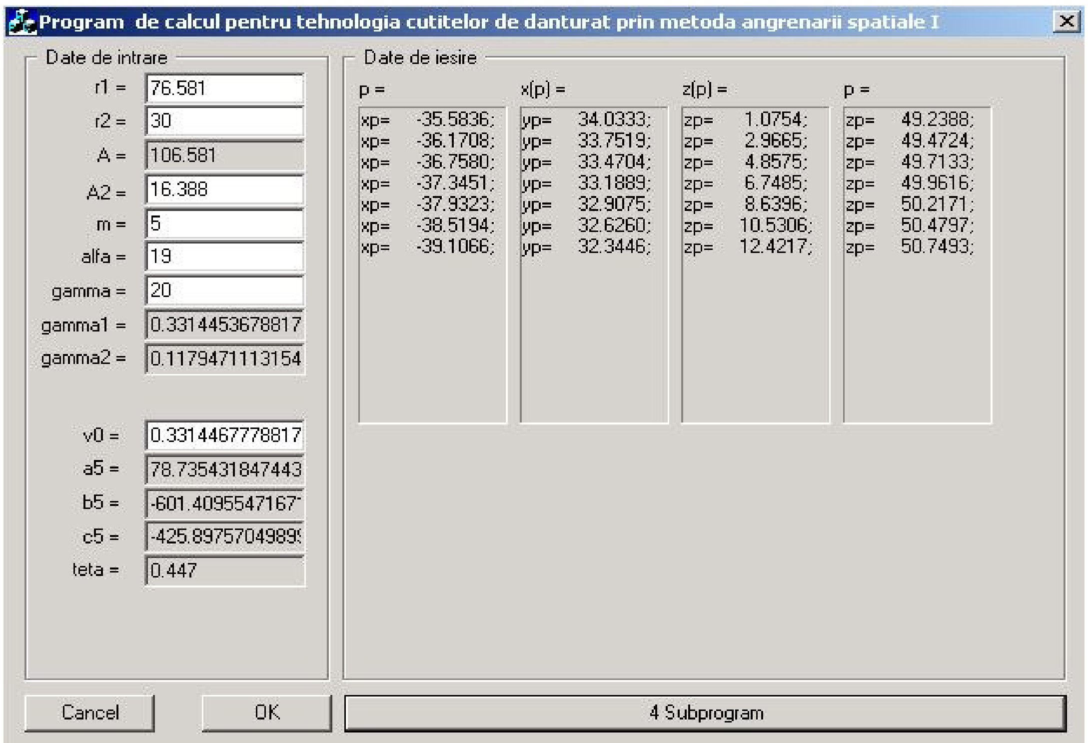

Figure 1 The program’s interface

deviations, the author has drawn up a program in the Visual C++ programming environment [2]. The program successively reads the names of the files and executes the calculation of each particular data set separately.

The program calculates using the algorithm:

-the independent parameter p dependent on the knife’s module;

-the generating surface’s coordinates;

-the coordinates of the abrasive tool’s surface;

-the real positioning surface’s coordinates;

-the deviations of the chipping edge from a line that passes through its extreme points;

-the maximum deviation Δ.

2. THE MODELING PARAMETER

The parameters employed while executing the pattern are:

-geometric elements of the knife:
- back angle α=19º
- angle of departure γ=20º
- knife module m=5 mm

-elements of the tool assembly of the first/second order:
- exterior radius of the technological head r1 = 76.581 mm
- medium radius of the abrasive body r2 = 30 mm
- propeller pitch p = 100 mm
- pattern structure:
- number of points on the profile: 7
- number of evaluation sections: 7

3. CALCULUS PROGRAM

Calculus program for the technology of toothing knives using the spatial gearing method (figure 3).

```
m_fR1 = 0.0f;
m_fR2 = 0.0f;
……………………………………………
a5 = m_fA * (m_fA2 * tan(RadianDe(m_iAlfa)) * sin(RadianDe(v0)) - cos(RadianDe(v0)) * tan(RadianDe(m_fGamma2)) + (m_fR1 - 1.104) * cos(RadianDe(v0));
b5 = -m_fA * m_fA2 * tan(RadianDe(m_iAlfa)) * cos(RadianDe(v0));
c5 = -m_fA2 * tan(RadianDe(m_iAlfa)) * cos(RadianDe(v0)) * (m_fR1 - 1.104);
m_fTeta = m_fV + 2 * atan((a5 - sqrt(a5 * a5 + b5 * b5 - c5 * c5)) / (b5 + c5));
void CProgram1Dlg::S4()
```

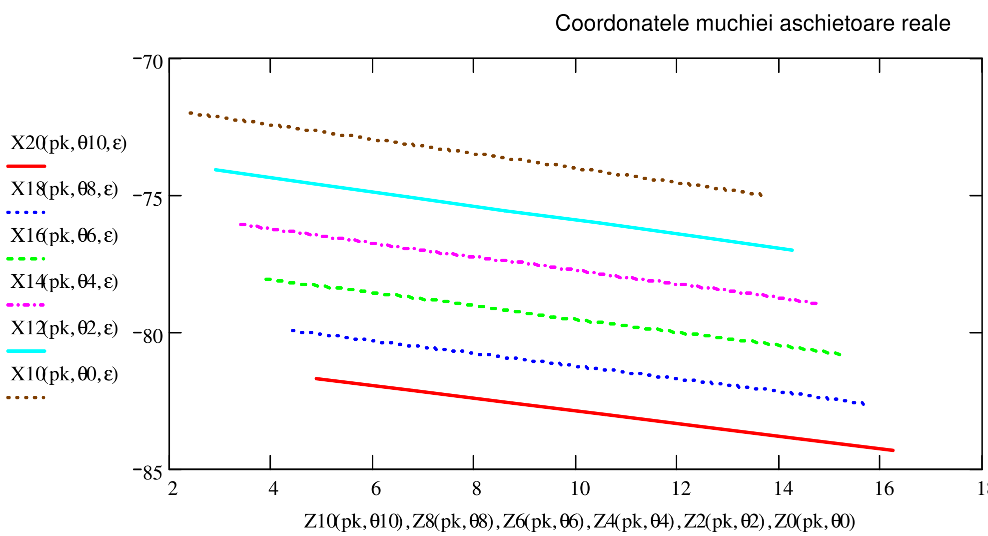

Figure 2 The coordinates of the chipping edge

4. THE MEASUREMENTS RESULTS

The simulation results were obtained by taking into consideration the following parameters:

-number of sections of the real positioning surface:6

-number of points on the profile:7

-maximum permissible tolerance: 0.08 mm

5. CONCLUSIONS

The “Calculus program for the technology of toothing knives using the spatial gearing method” program was drawn up. It allows the numeric research of the geometry of the positioning surface of knives used for toothing conical gears with curved teeth.

The advance relieving through rectification is a continuous process. It eliminates the negative dynamic phenomena that appear in the case of cam relieving because of the alternative axial movement.

Performing a study case relative to the application of the mathematical model presented, with reference to the I tool – II tool assembly tool on the Niles type worm cutter-rectifying machine, that reproduces, on an experimental scale, the real processes of relieving for the case of rectification with a conical abrasive tool.

The numeric results obtained from the program for the toothing knives with teeth arranged in a circular arc emphasize the following:

-the deviations of the chipping edge are set inside the permissible tolerance;

-the working diameter of the toothing head does not suffer modification after the resharpening of the knives in the resistance limits of the knife(2/3 of the thickness).

The numeric results show that the profile obtained through the helical relieving with advance is situated within deviations under 0.05 µm (about 60% of the maximum permitted value)

REFERENCES

1. Litvin, F.L. *Gear Geometry and Applied Theory.* University of Illinois, Chicago. PTR Prentice Hall, Englewood Cliffs, New Jersey 0763,1994

2. Pantea, I. Contribuţii privind tehnologia sculelor de danturat roţi dinţate conice cu dinţi curbi.Teză de doctorat, Universitatea din Oradea, 2004.

3. Pantea, I. Studiul teoretic al sculelor de danturat roţi conice cu dinţi curbi. Sisteme de coordonate, matrici de transformare. Analele Universităţii Oradea, 2002, pg. 215-218.

4. Maroş, D. *Cinematica roţilor dinţate*. Editura tehnică Bucureşti,1959.

5. Grămescu, Tr. ş.a. *Tehnologii de danturare a roţilor dinţate. Manual de proiectare*. Ed. Universitas, Chişinău, 1993.

6. Şteţiu, G. ş.a. *Teoria şi practica sculelor aşchietoare, vol.I, II, III.* Editura Universităţii Sibiu,1994,