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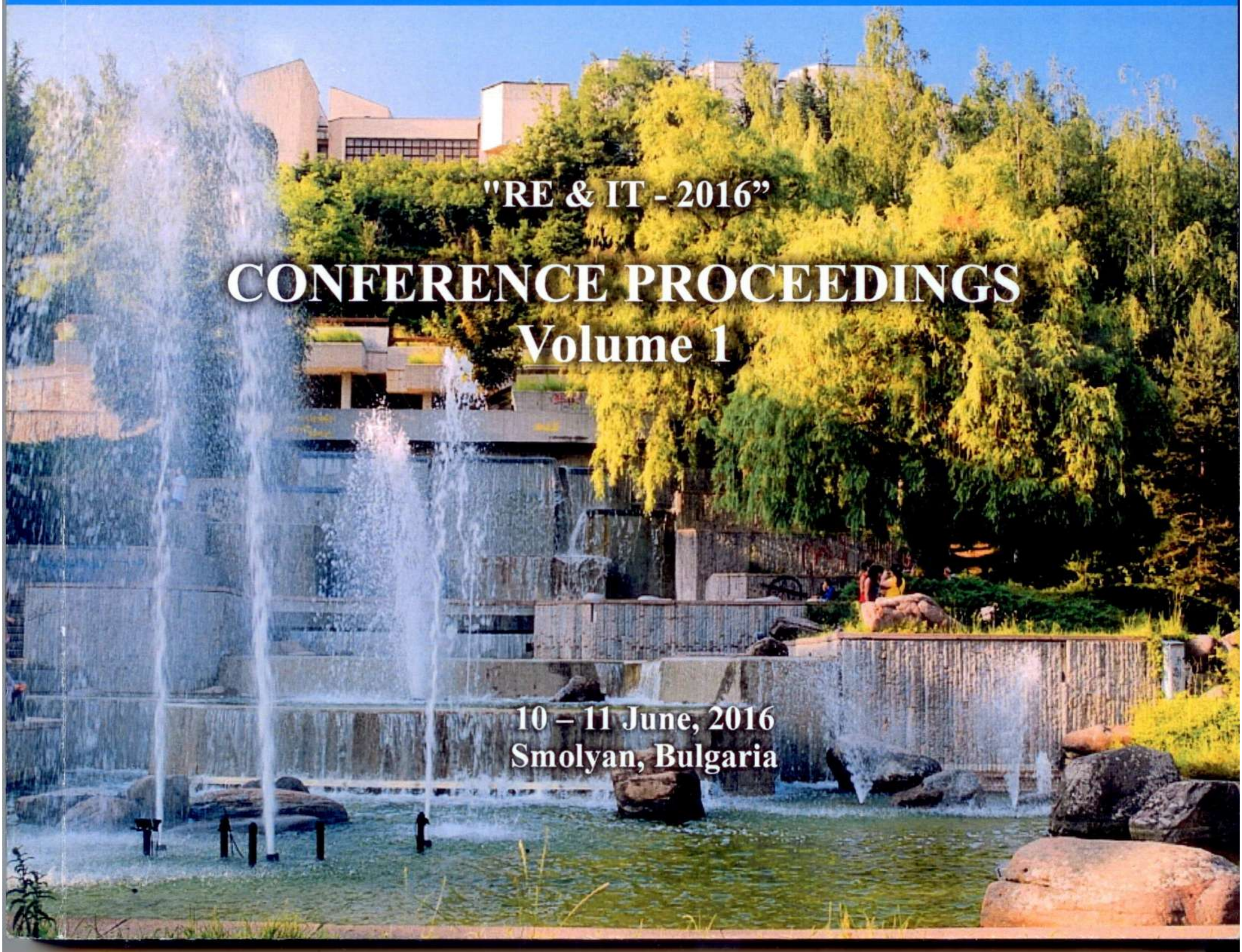

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HIGH-PROCESSING METHODS FOR LATHES DETAILS USING CNC MACHINES

MIROSLAV ALEKSIEV, STANISLAV ALEKSIEV

Abstract: *The article shows high performance methods for processing turning workpieces milling tools with parallel axes to the axis of the workpiece. Derived are equations the path of a point on the cutting edge of the tool, which is a prerequisite to determine its geometry.*

Key words: high-performance methods, turning to milling tools

1. Introduction

Modern CNC machines are able to implement the turning and milling processes on the same machine. These machines are called multi-processing machines (multitasking machine). Combine the advantages of milling and turning. Processing with tool with a plurality of cutting teeth such as mills, many times superior in performance planing tool, which by definition is a tool with a cutting wedge. With the advent and widespread use of details of weave-called engineering plastics require their fast processing. All of the above determines the relevance of the topic.

2. Schematic diagrams of processing lathes with milling tools surfaces and types of machines such technological capabilities

Silhouette of the cylindrical surfaces with milling tools can be obtained by:

- submission of the milling cutter in the axial direction during rotation of the workpiece (figure 1).

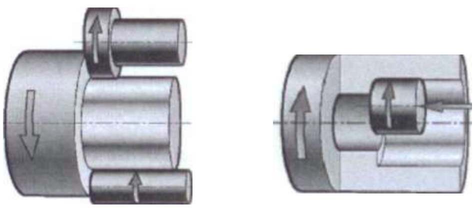

Figure 1. Processing of cylindrical surfaces with axial submission tool

- submission of milling cutter in a radial direction during rotation of the workpiece (figure 2)

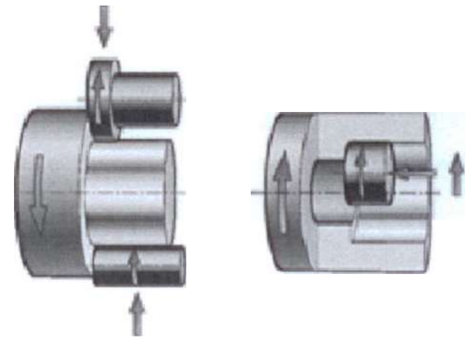

Figure 2. Processing of cylindrical surfaces with radial submission too!

By moving the tool simultaneously in two directions, it is possible to produce:
- cam surfaces, crankshafts.
- conical surfaces, but requires processing by 5 axes.
- details such as turbine blades, by feeding the tool in more than 2 axes while rotating the workpiece.

Turning center machines are designed as lathes inclined body with a power tool in the C-axis and Y-axis. They perfectly fit for the production of parts that require viability of milling with subsequent milling and drilling operations. It saves time because it takes only a process of establishment and do not lose accuracy due to the establishment of another machine. Such machines are manufactured by different companies producing metal cutting machines. Most manufacturers divide them into separate groups according to various criteria.

The machines are similar to the conventional lathe, but they can be mounted in rotating tools. Have the opportunity to managed additional axes as the C-axis, Y-axis.

Representatives of this group are machines:

- QUICK TURN NEXUS, MAZAK

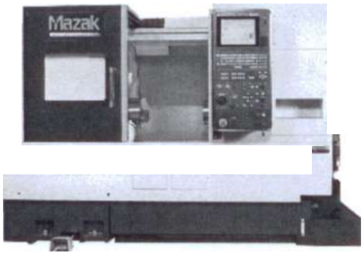

***Figure.* 3.** *QUICK TURN NEXUS, MAZAK*

- QUICK TURN SMART, MAZAK

***Figure.* 4.** *QUICK TURN SMART, MAZAK*

- LB SERIES, OKUMA

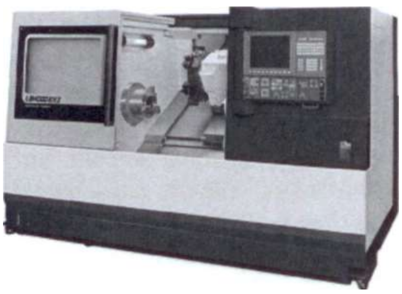

***Figure.* 5.** *LB SERIES, OKUMA*

MAZAK INTEGREX

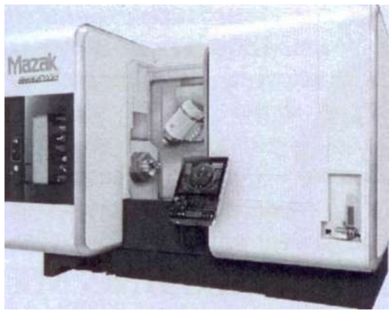

***Figure.* 6.** *MAZAK INTEGREX*

3. Equations of the trajectory of the point of cutting edge of tool

Equation (1) point of cutting edge of tool with axial feed f:

$$x = a*\cos\phi + d*\cos(i_{12}*\phi)$$
$$y = a*\sin\phi + d*\sin(i_{12}*\phi) \quad (1)$$
$$z = (f/360)*\phi$$

where:

a – wheelbase;

d – tool diameter;

f – step of the helical line along the axis „z“;

i_{12} – ratio between the two rotating movements - cutter around its own axis with speed n2 and the workpiece around its axis with speed n1 or i12=n2/n1;

ϕ – angle parameter in degrees.

Figure 7 shows a path of a point on the cutting edge of the rotary tool in the area of the workpiece during machining of the cylindrical surface, wherein $\varphi \ \varepsilon \ (0^o, 5400^o)$.

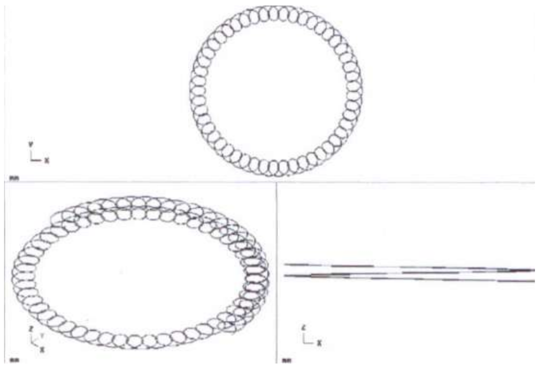

***Figure.* 7.** *Trajectory of a point on the cutting edge of the rotary tool in the area of the workpiece during machining of the cylindrical surface*

Figure 8 shows a workpiece with a proposed scheme of cutting.

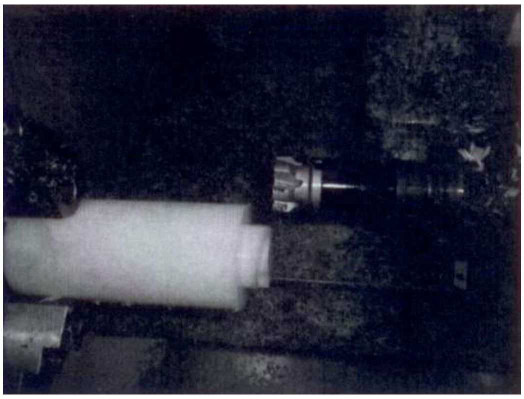

Figure 8. *Cylindrical turning*

Equation (2) to the point of cutting edge of tool with radial feed f:

$$x = (f*\cos\phi)*(1/360)*\phi + d*\cos(i_{12}*\phi)$$
$$y = (f*\sin\phi)*(1/360)*\phi + d*\sin(i_{12}*\phi) \quad (2)$$
$$z = 0$$

Figure 9 shows the trajectory of the point of cutting edge described by equation (2).

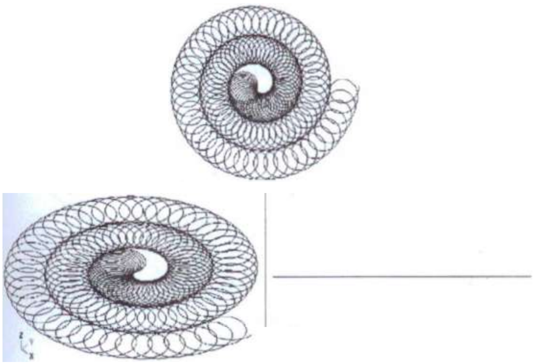

Figure 9. Trajectory of a point on the cutting edge of a rotary tool with a radial feed

When turning to the milling of conical surfaces, each point of the cutting edge of the cutter moves along the path with equation (5):

$$x = (d*\cos\phi)*(1/360)*\phi+d*\cos(i_{12}*\phi)$$
$$y = (d*\sin\phi)*(1/360)*\phi+d*\sin(i_{12}*\phi) \quad (3)$$
$$z = (f/360)*\phi$$

Figure 10 shows the trajectory of the point of the cutting edge described by equation (3).

Figure 11 shows a workpiece with the proposed scheme of cutting processing conical surface.

When processing a conical surface with the turning tool is necessary to carry out several cylindrical transition of different lengths, while in the case the processing is carried out with only one transition on screw conical surface. Cutter began work on the cone axis and ends at its base. Performance is much larger, and the chip is interrupted due to the nature of the work of the milling tool. Interruption is done with each entry and exit of tooth cutter located in contact with the workpiece.

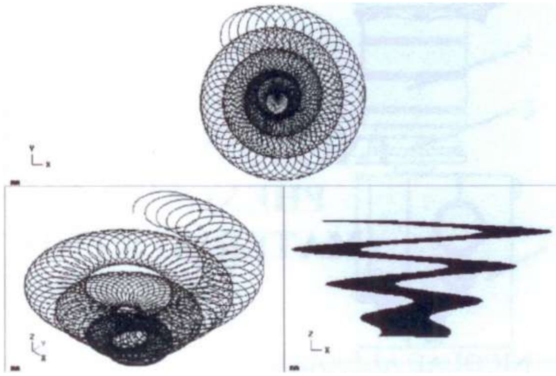

Figure 10. Trajectory of a point on the cutting edge of a rotary tool with both radial and axial feed

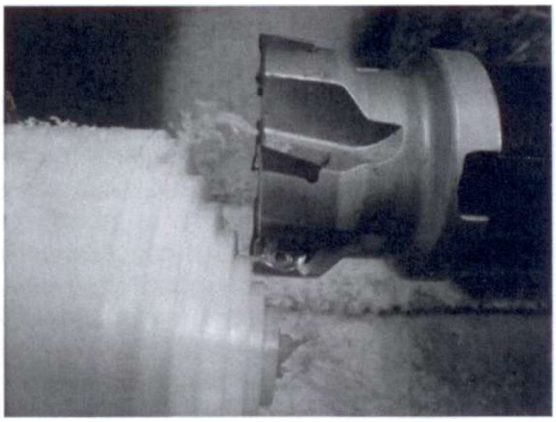

Figure 11. *Tapered turning*

4. Conclusion

Proposed methods for processing lathe details on modern CNC machines. Combined advantages of milling and turning. Treatment with plurality of cutting teeth tool far superior in performance turning tool.

References

1. CAD/CAM Software Mastercam V9

Contact

Department of Electrical Engineering
Technical University–Sofia, Branch Plovdiv
25 Tsanko Dystabanov St.
4000 Plovdiv
BULGARIA
E-mail: stanislaval_al@abv.bg
E-mail: miro.0328@gmail.com