



PLOVDIV UNIVERSITY "PAISHI HILENDARSKI"



TECHNICAL COLLEGE OF SMOLYAN

**XV International Scientific Conference**

**RENEWABLE ENERGY &  
INNOVATIVE TECHNOLOGIES**

**"RE & IT - 2016"**

**CONFERENCE PROCEEDINGS  
Volume 1**

**10 – 11 June, 2016  
Smolyan, Bulgaria**

<i>Iliyana Chakarova</i>	
E-learning in the Plovdiv University - status and perspectives (results of an experiment) . . . . .	71
<i>Ivan Stoyanov Valkov</i>	
Hybrid wind-generating oscillatory inductive equipment for producing electric current . . . . .	76
<i>M. Prieler, M. Leeb, T. Reiter</i>	
Statistical analysis of Austrian Energy Performance Certificates, time period 2006-2015. . . . .	78
<i>Milena Bundeava, Dinko Ortakchiev and Angel Chekichev</i>	
Digital processing of RGB images using MATLAB GUI . . . . .	85
<i>Miroslav Aleksiev, Stanislav Aleksiev</i>	
High-processing methods for lathes details using CNC machines . . . . .	89
<i>Nicolae Alexandru Stoica, Alina Maria-Petrescu, Andrei Tudor, Alexandru Valentin Radulescu</i>	
Experimental studies of the friction phenomenon for steel on other materials friction couples at low sliding velocities . . . . .	92
<i>Nickolay Bakharev, Boris Gorshkov, Ruslan Dikov</i>	
Formation Of Continuous And Multilevel Technical Education . . . . .	96
<i>Ranjeet Rana, Aman Gupta, Sunny Narayan</i>	
Review of working of aero-engines . . . . .	102
<i>Rustem Manatbayev, Assylbek Tulepbergenov, Saltanat Bergalieva, Kalasov Nurdaulet</i>	
On the development of a numerical calculation of a rotation the wind turbine Darrieus. . . . .	108
<i>S. S. Petrov</i>	
Rationalization of expenses for the lighting of road and urban tunnels . . . . .	115
<i>S. S. Petrov, A. S. Pachamanov</i>	
Selection of classical and/or leds lighting for road tunnel under criterion lifecycle costs of the installation . . . . .	121
<i>Seda H. Bostanci</i>	
The effects of wind energy projects in urban planning . . . . .	128
<i>Sergej V. Fedorov</i>	
Energetic interpretation of friction coefficients with position of energy balance of friction. . . . .	132
<i>Sorinel Toderas Siretean, Ilie Musca, Luminita Irimescu</i>	
Numerical study of the rolling tendency . . . . .	138
<i>Stanislav Aleksiev, Miroslav Aleksiev</i>	
Deciphering the profile of the stator of the Wankel engine . . . . .	142





## 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*

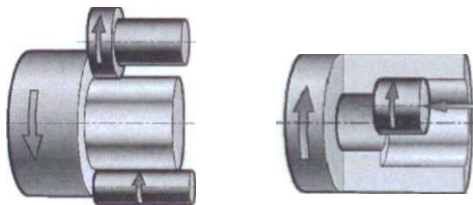
### 1. Introduction

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

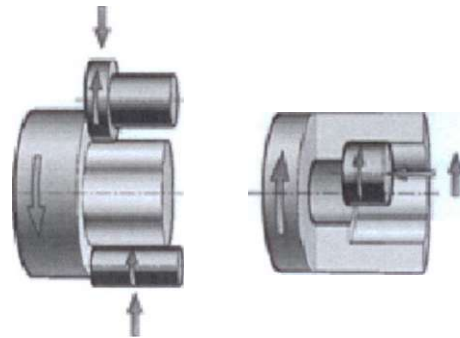
Silhouette of the cylindrical surfaces with milling tools can be obtained by:

- 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 tool!*

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

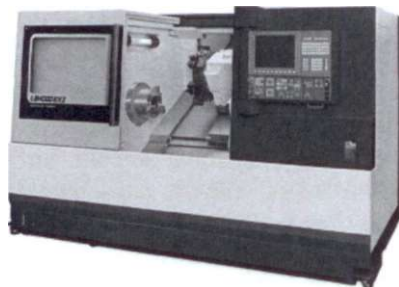


Figure 5. LB SERIES, OKUMA

MAZAK INTEGREGX



Figure 6. MAZAK INTEGREGX

### 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:

$$\begin{aligned} x &= a \cdot \cos \phi + d \cdot \cos(i_{12} \cdot \phi) \\ y &= a \cdot \sin \phi + d \cdot \sin(i_{12} \cdot \phi) \\ z &= (f/360) \cdot \phi \end{aligned} \quad (1)$$

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  $n_2$  and the workpiece around its axis with speed  $n_1$  or  $i_{12} = n_2/n_1$ ;

$\phi$  – 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  $\phi \in (0^\circ, 5400^\circ)$ .

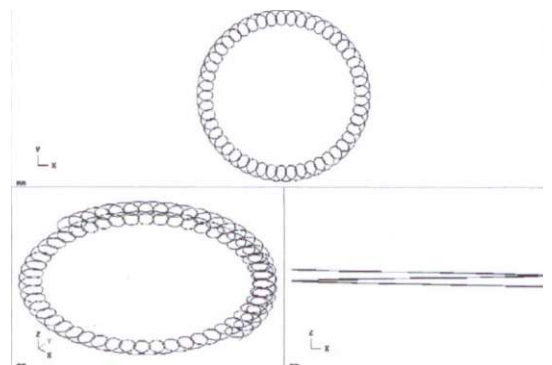
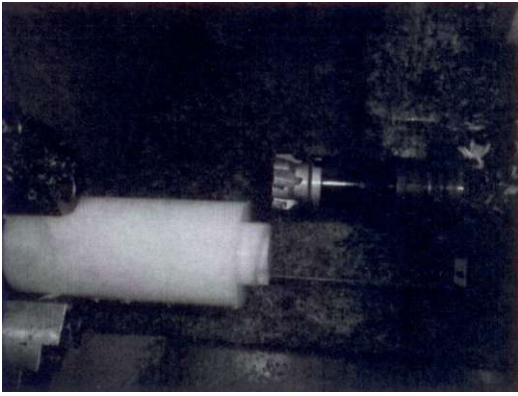


Figure 7. Trajectory of a point on the cutting edge of the rotary tool in the area of the workpiece during machining of the cylindrical surface

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



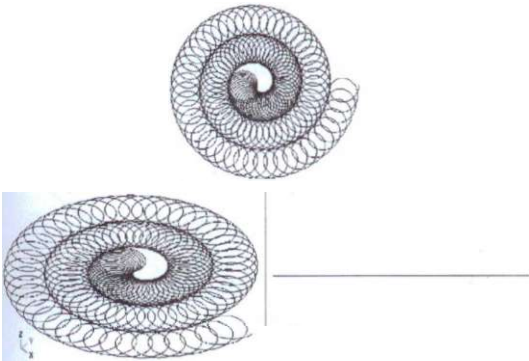


**Figure 8.** Cylindrical turning

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

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

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):

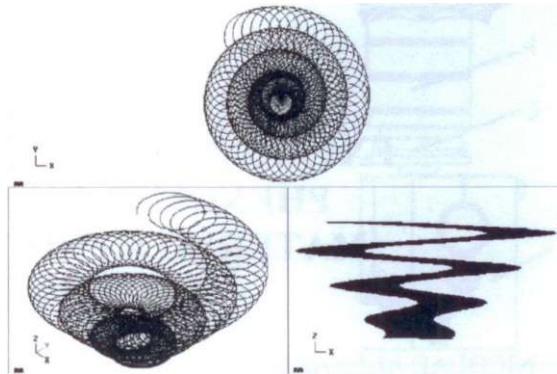
$$\begin{aligned} x &= (d \cdot \cos \phi) \cdot (1/360) \cdot \phi + d \cdot \cos(i_{12} \cdot \phi) \\ y &= (d \cdot \sin \phi) \cdot (1/360) \cdot \phi + d \cdot \sin(i_{12} \cdot \phi) \\ z &= (f/360) \cdot \phi \end{aligned} \quad (3)$$

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

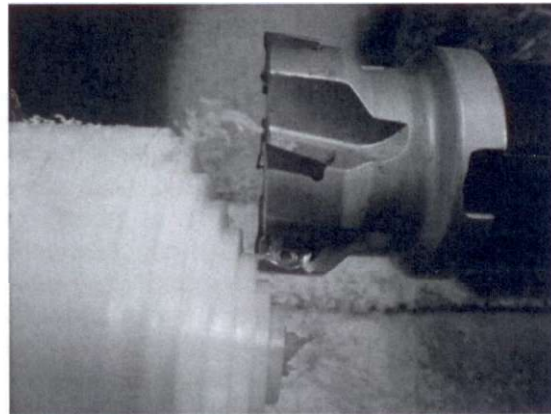
Figure 11 shows a workpiece with the proposed scheme of cutting processing conical surface.

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](mailto:stanislaval_al@abv.bg)  
 E-mail: [miro.0328@gmail.com](mailto:miro.0328@gmail.com)