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Innovative tools for oblique cutting

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Abstract

Development of machining process depends of cutting tools and machine tools. Various new tools are being developed and tested. For example special tools for oblique cutting or mechatronics tools. Oblique cutting process using special tools with continued cutting edge and high value of cutting angle λ_s make new possibilities to research. This tools characterized by single continued edge without the corner of the edge. Task of corner now have the current point of contact between the continuous cutting edge and the machined surface. Single edge tools exist with straight and circular edge. This tool are very useful especially for surface finishing In paper was presented many new solution of cutting tools for oblique cutting both with straight and curvilinear cutting edge with high value of λ_s angle (60^o). Was developed both virtual models of this tools and its prototypes. CAD models are convenient for analyzing the geometry of these tools.

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Keywords: turning; innovative tools; oblique cutting; straight cutting edge; curvilinear cutting edge.

1. Introduction

Cutting-edge advances are being made both in the way of cutting edge material improvement and in the improvement of cutting tool design, especially in the cutting edges [1-4].

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There is a desire to increase productivity and efficiency by intensifying existing methods and introducing qualitatively new methods based on, inter alia, changing the nature of the mechanical impact on the sliced layer.

Examples of tools with rectilinear edges without corner was presented in [2-5].

An additional advantage of single-edged tools is the possibility of increasing the tool life by periodically displacing the worn cutting edge portion by a fraction of the active length of the cutting edge section. [4,6-8]. In single-edged cutting, a *Ra* area of 0.32 to 1.25 μm is achieved at feeds from 0.2 to 0.4 mm/rev [9]. The disadvantage of using these tools is to limit their use to free surfaces.

As single-edged tools are also used cutting edges in the form of a circular arc. They are used both in orthogonal and oblique cutting [10-13]. The use of single-edged tools in sloped cutting provides a favorable surface finish characteristic [9,14]. Was elaborated model of oblique cutting [15] to predict the cutting forces, the chip flow direction, the contact length between the chip and the tool and the temperature distribution at the tool-chip interface which has an important effect on tool wear.

The paper presents examples of single-edged tools developed at the Department of Production Engineering at the UTP University of Science and Technology in Bydgoszcz, (Poland).

Nomenclature

λ_s	Main cutting edge angle [°]
γ_n	Normal *r*ake angle [°]
α_n	Normal Back angle [°]
r_ε	Nose radius [mm]
R*zt*	Surface roughness [μm]
f	Feed [mm/rev]
d	Workpiece diameter [mm]

2. Tools with continued cutting edge

The essence of single continued edge tools is that they cannot distinguish the corner of the edge. Task of corner now have the current point of contact between the continuous cutting edge and the machined surface. Single edge tools exist with straight and circular edge. The essence of single-edged straightening tools is the use of straight edges, which makes it possible both to turn longitudinal (Fig. 1,2a) or transverse (Fig. 2b). Eliminating the corner from conventional lathe tools increases the active cutting edge length, which results in a reduction in its individual power and thermal load [3], and thus results in reduced edge wear [3]. Single-edged tools offer the possibility of speeding up the processing of a number of materials that cannot be realized with the use of conventional tools.

The convenient technique for obtaining this surface is the 3D virtual models of a twisted rectilinear cutting edge in a machined surface. These models were realized both for longitudinal turning (Fig. 1) and transverse turning (Fig. 2). The transverse turning illustrates the effect of the angle λ_s on the curvature of the hyperboloid surface (Fig. 3). The advantage of such single-edged tools is that the cutting edge is rectilinear and the edge of both rake and back surfaces are planes.

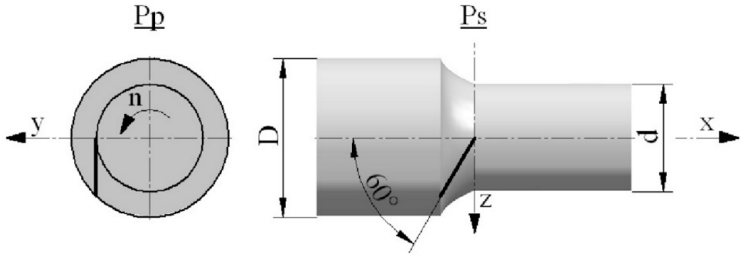

Fig. 1. The longitudinal turning feature of a right-handed straight edge with λ_s = 60°