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BLADES OF CUTTING TOOLS AND ECOLOGY

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Abstract. In a quest to obtain these advantages, users are requiring their cutting edges to have progressively smaller tolerances, e.g. of radius, bevel length and angle. This increases requirements in the manufacturing of predefined cutting edge geometries. According to established procedures, up to 100% of all tools have to be tested. Typical tolerances of <10µm are hardly leaving any margin for manufacturing or measurement errors.

Continuous improvement of cutting edge rounding

Due to varying process conditions - Hardness of materials, cutting speed etc. - there are no universal tools, but such being optimized for specific tasks instead. Despite of existing experiences which tool to use for a certain purpose, a further optimization by a better control of cutting edge geometries can always be obtained.

A variety of rounding methods are available, like drag grinding, brushing, magnet finishing or sanding.

The measuring principle

The method of phase-measuring fringe projection, used by GFM, immediately provides accurate height values, without depending on object contrasts. The full height range is measured with a single short fringe sequence. Other than with many other methods, a vertical scanning is not required.

Between 300 000 und 5 million pixels are acquired in one single measurement, simultaneously capturing a large height range. By phase measurement, the fringe positions are determined up to less than 1/100 of the fringe width. Hence the height resolution does not depend on the camera resolution and is usually even at least 10 times better. Surface averaged values (e.g. for flatness measurements) are even several times more accurate. The measurement including analysis is carried out extremely fast and with outstanding precision.

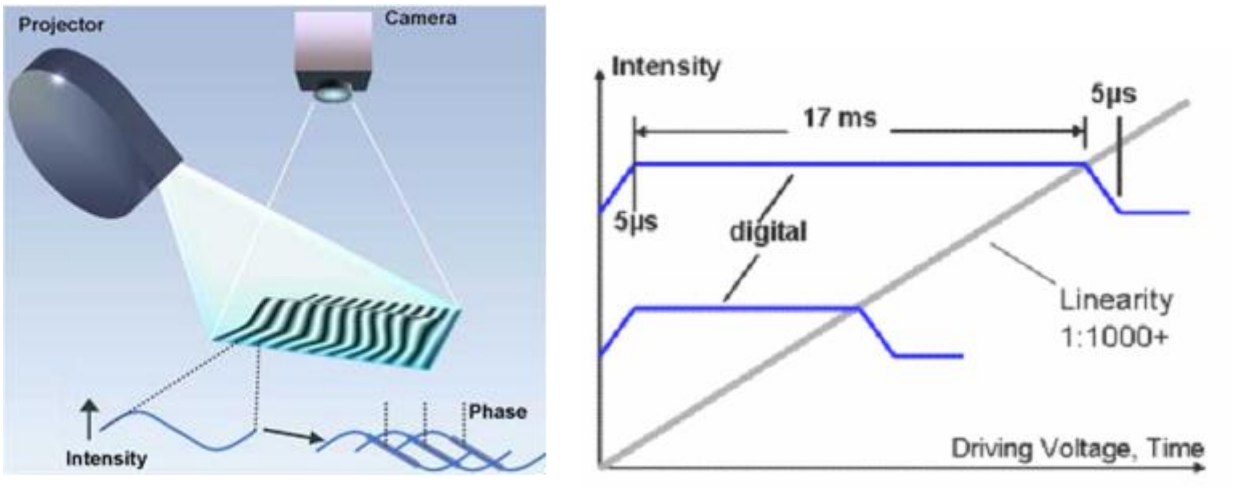


Fig. 1. Fringe projection: precise phase measurement

Fig. 2. MikroCAD[lite]

Example cutting edge measurement: MikroCADlite is particularly suitable for the cutting edge radii from 10...40 micrometers, as are required in hard-milling. It enables a fast, accurate and economical control of edge radii, analyzing the entire blade areas automatically and delivers reliable, user-independent results.

Example surface measurement on rubber rollers: surface roughness and microstructures are decisive for the functionality of many industrial processes. With offset printing, for example, the ink is transferred to the paper via a rubber roller. Here, the structure of the rubber surface plays a central role. MikroCAD sensors here allow for an efficient control.

The new MikroCADllte systems by GFM are ideally suited for mobile use. Fast data acquisition allows hand-guided measuring and therefore a fast and reliable control of surfaces and profiles, anywhere and anytime.

For a large number of applications, a measuring volume of 40x30x20 mm may be well suited. Here, a height resolution of a few micrometeras can be achieved, which allows not only a shape acquisition but also the analysis of surface roughness.

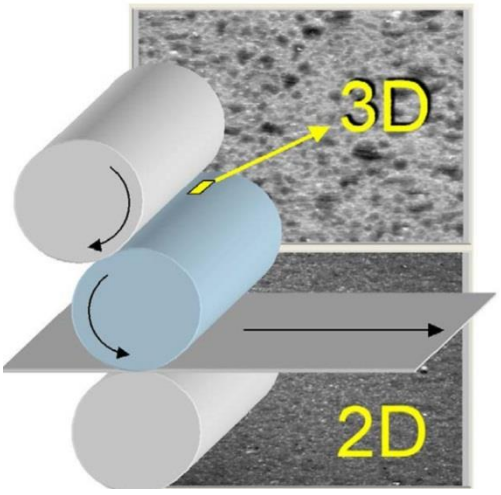


Fig. 3. Example: cutting edge measurement

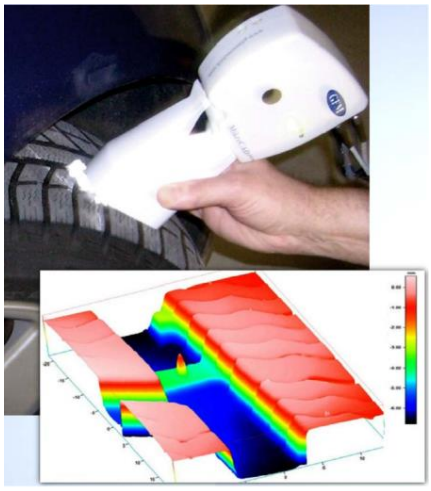


Fig. 4. Structures or material defects

Deep profiles (image) as well as subtle height variations are reliably acquired. Flatness is measured as reliably as are embossed structures or material defects, e.g. of leather or plastic surfaces.

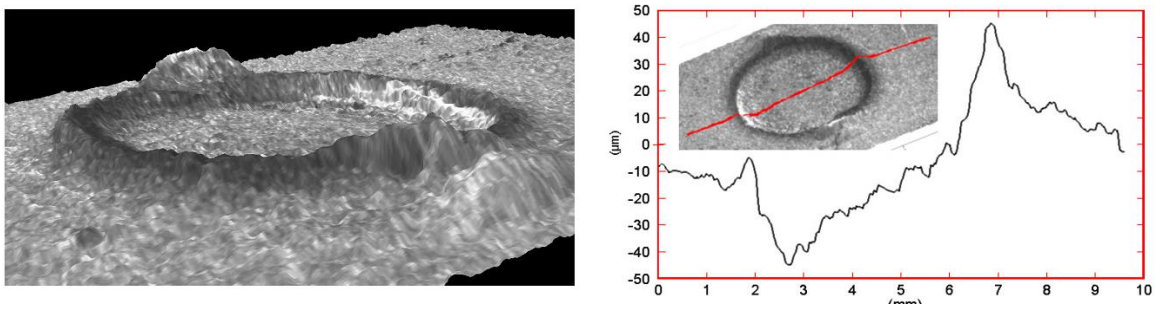
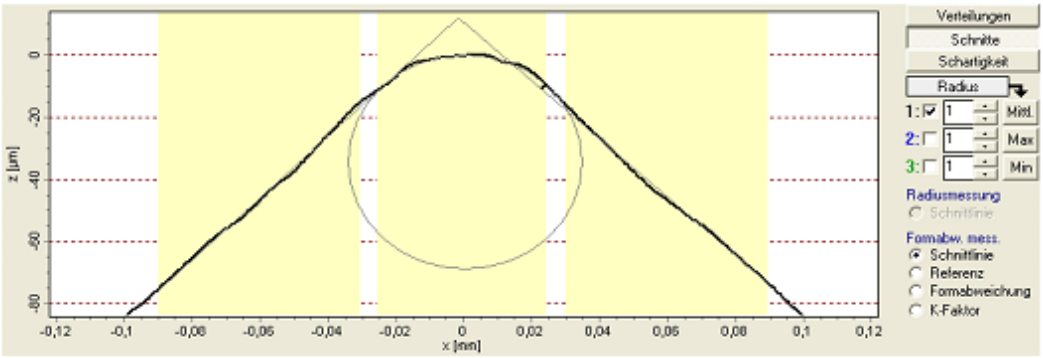


Fig. 5. Weld spot measurement, performed by GFM 3D compact sensor

GFM's compact sensors are so fast that even smaller measuring areas with resolutions in the µm range are possible for hand-guided control and measuring tasks, e.g. for the inspection of welding spots (above figure).

Software for cutting edge evaluation



Messwert	Einh.	Mittel	Nr.	Min	Nr.	Max	Nr.	StdAbw
Radius	µm	27,9	30	23,5	100	32,8	4	2,615
Winkel	°	91,53	61	90,45	54	92,65	33	0,530
Abstand links	µm	0,6	53	0,0	15	1,5	19	0,389
Abstand rechts	µm	0,5	56	0,0	90	1,2	38	0,364
Abstand	µm	0,6	66	0,0	15	1,5	19	0,381
Abweichung links	µm							
Abweichung Radiusbereich	µm	0,7	32	0,2	54	1,2	99	0,214
Abweichung rechts	µm							
Abweichung	µm	0,7	32	0,2	54	1,2	99	0,214
K-Faktor		0,971	16	0,750	89	1,188	45	0,110
Radiusdelta	µm	12,0	79	9,6	95	14,8	15	1,304

Fig. 6. Section image of a single radius with circle fitting

Detailed analysis

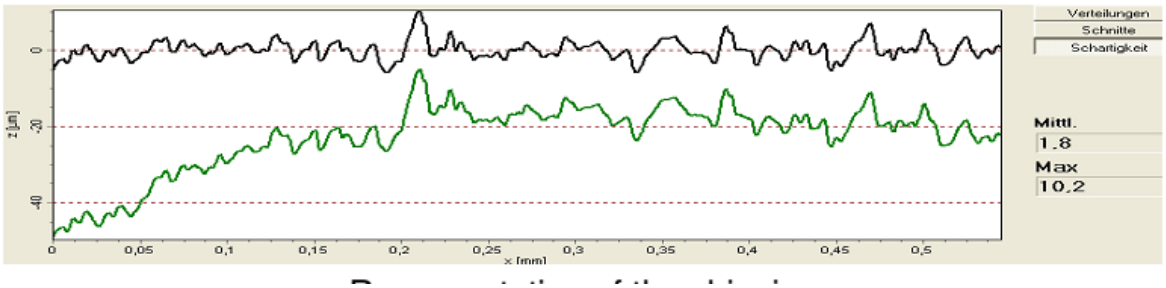


Fig. 7. Representation of the chipping

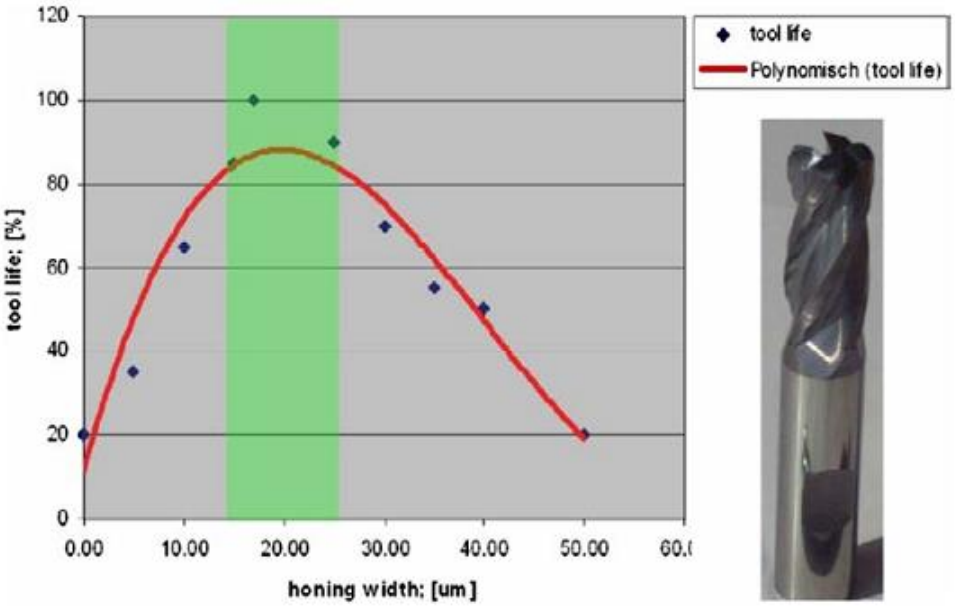


Fig. 8. The tolerance band for optimum tool life (green) is relatively narrow (Source: PLATIT AG).

In order to prove the absolute measurement accuracy, GFM developed radius standards, the radii radius, angles and deviations from an ideal geometry of which are certified by the Swiss Federal Office of Metrology (METAS). All GMF measuring devices are tested with these standards. The micro geometry of cutting edges affects machining process results in all aspects. Extensive test series have proven that the cutting edge radius must be maintained to a high precision. Typical applications require compliance with the optimum rounding radius to a few micrometers, even in case of radius values of, e.g., 20 or 30µm. Up to now, no rounding method is known that reliably provides accurate and reproducible results. Therefore, a continuous monitoring and process adjustment are indispensable. This is only possible by precise measurement.

Measurement of arbitrary rounding, edges and burrs

Roundings, bending radius, burrs and fracture edges often play a decisive role in industrial processes. MikroCAD lite is predestined for such applications. To the analysis of a fracture edge is shown.

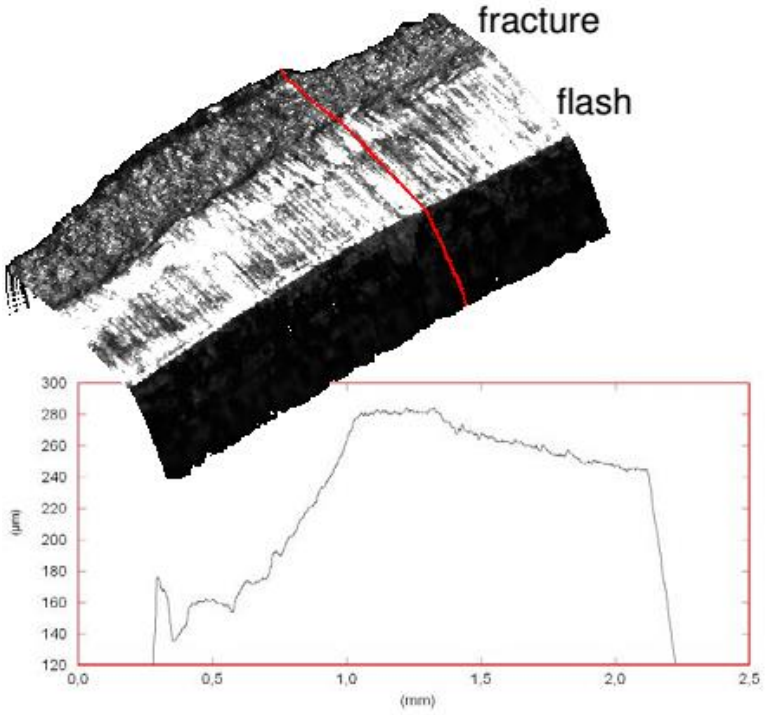


Fig. 9. Analysis of a fracture edge

Wear measurement

GFM technology is particularly suitable for fast 3D measurement of wear on surfaces of parts and components of most various kinds and materials. Worn surfaces of almost any size can be measured and scanned with up to 2 million measuring points. MikroCAD with the software option TopoXenios allows particularly detailed wear measurements - an ideal addition, e.g., for the cutting tool edge measurement.

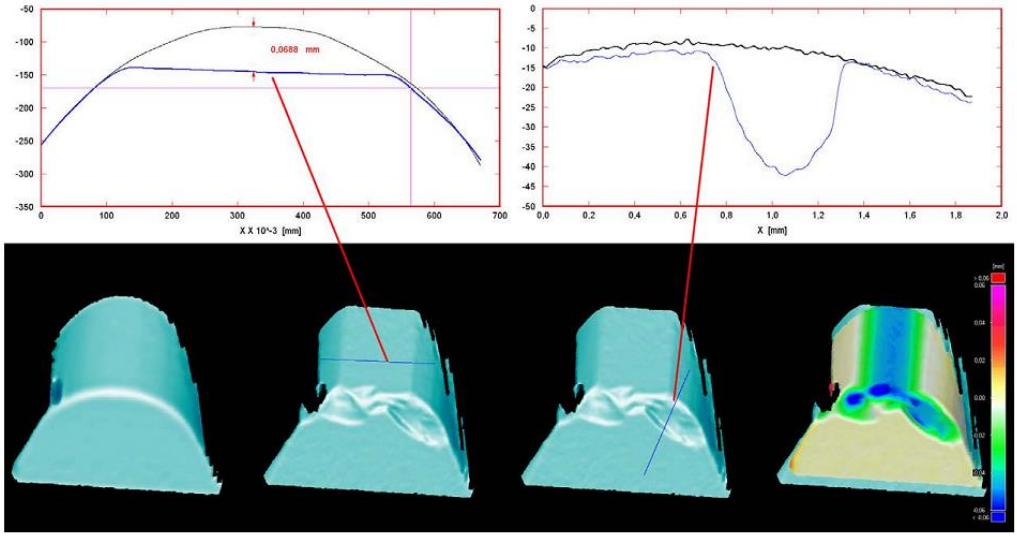


Fig. 10. Left: new cutting edge. Center: wear image with profile sections. Right: difference image

Conclusions

The use, tool preparation and proper care of high-precision company GFM LMI Technologies (Germany) measuring devices (Series MikroCad) has a significant impact on environmental protection:

- Accurate tools affect less materials consumption (accurate blanks-less waste, faster technological process).
- Proper handling and care of tools reduces tool wear and saves valuable tool steel (reduction of tool steel consumption indirectly reducing air pollution and high heat flux to the atmosphere (foundries)).

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