Cutting Tool Quality Inspection

Monitoring the quality of the cutting edge of milling cutters and chisels is mostly done through manual labor.
Since the quality of milling cutters and chisels continuously increase the difficulty for human inspection increase too and will be more time consuming.
Vision systems can help to inspect and measure the cutting edge of a milling cutter or chisel very accurate and objectively with high speed.

The measured data is important to improve the current quality level and can be used for very fast process control. The measured data can be used for a measure report or quality certificate.
The required images of the cutting edge as well as the measured damage data can be archived and use for quality improvement purposes or prevent claims.

In order to inspect the cutting edge of a cutter, a good image of the edge has to be created which in itself is not trivial, because of the spiral shape.
The optics depth of field and an appropriate lighting to create a good image of the curved cutter edge is challenging.

Damaged and not sharp cutting edge

To show the possibilities of vision to measure the cutting edge the bad parts or damages (reason to reject the cutter) of 3 cutters are shown in this report.

Cutting tool number 1

Color image 2 and subimage 3 visualizes the damaged cutting edge.
Total image size is about 4mm in horizontal direction and 3 mm vertically.

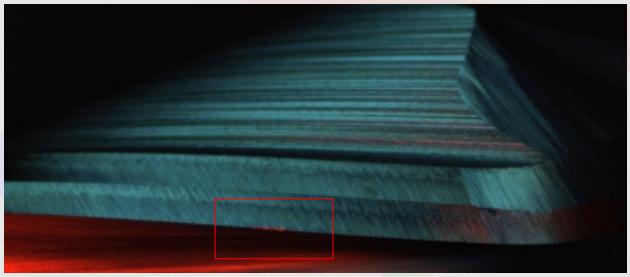


Image 2: RGB image cutting edge. The damage is visible in the red rectangle. See also subimage (Image 3).

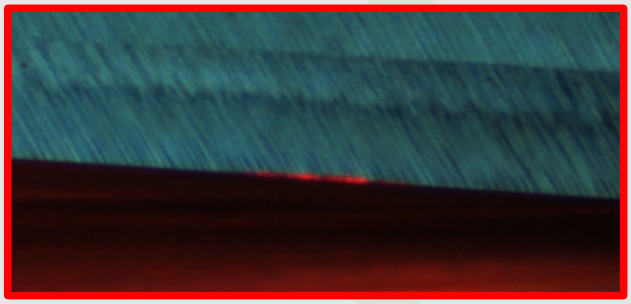


Image 3: RGB Subimage, red is the damaged edge.

To determine the feasibility of measuring the sharpness of the cutting edge, a feasibility study over a representative set of ball nose cutters is performed. This report contains brief the results of the feasibility study and shows the result of a subset of the tested cutters.
The cutters are all new and directly derived from the grinder.
The tested cutters are visual inspected but didn't match the quality level and are rejected.

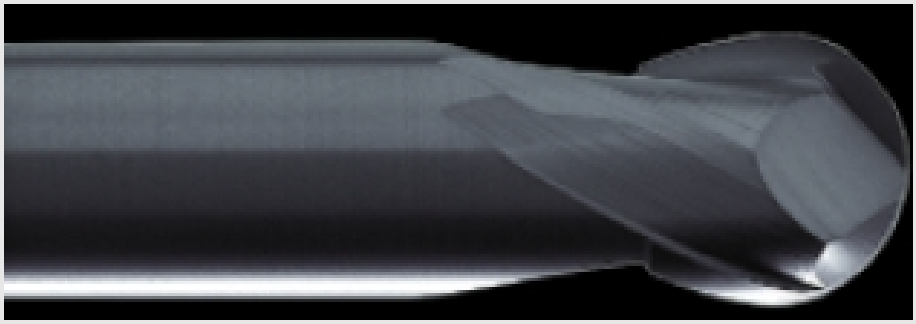


Image 1: Investigated cutter: ball nose cutter type.

Cutting Tool Quality Inspection

For reliable detection followed by an accurate measurement a monochrome camera gives a better result because of a higher resolution.

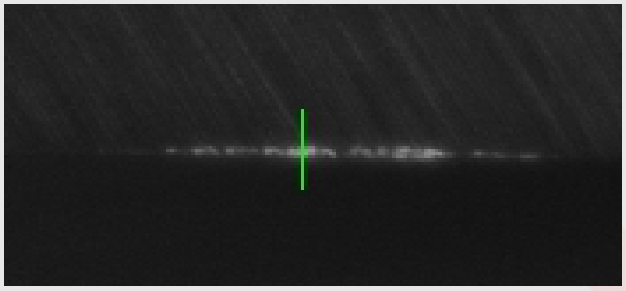
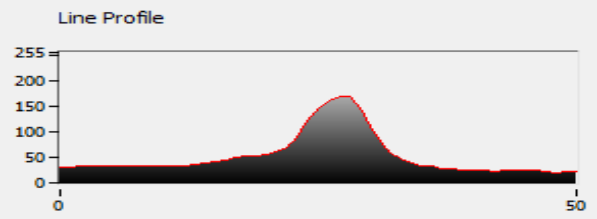


Image 4:monochrome subimage of the damaged edge.

Due of very high contrast (graph 5) a reliable



Graph 5:intensity profile in vertical direction of the defect.

detection of the damaged edge is possible. After a detection the geometrical dimensions of the damage is measured.

The width of the damage in image 4 is 11 μm and the length 295 μm.

Cutting tool number 2

Subimage 6 shows a large but thin damage at the cutting edge of a rejected cutter.

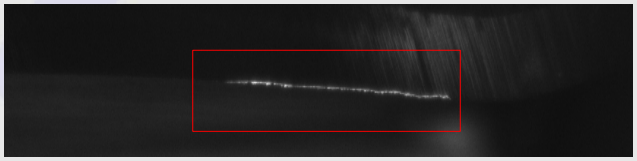


Image 6: Subimage of cutter number 2, the damage is clearly visible and detectable by vision, damage size width:4.9 μm; length: x: ~1100μm

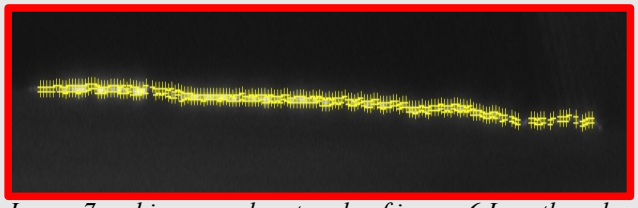
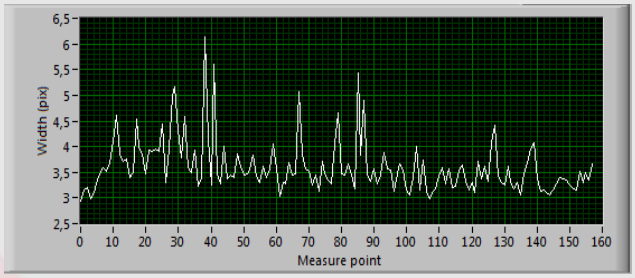


Image 7: subimage red rectangle of image 6 Length and width result of the damage. Yellow crosses are the detected damage points.

Image 7 shows the detected edges and the graphical representation (graph 8) shows the measured width of the damaged edge in pixels.



Graph 8: Measured width of the damage in pixels.

Scaling: =1.4 μm /pixel vertical and 7 μm/ pixel horizontal.

Cutting tool number 3

Even when the damage exceeds the 'linear' part of the ball nose cutter a reliable detection followed by an accurate measurement is performed. The width of this damage is 6.6 μm over a length of ~1680 μm.

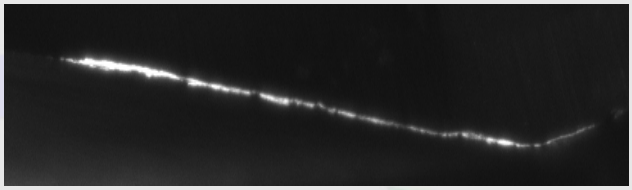


Image 9: Subimage cutter. Damage length about 1200 pixels (~1680μm).

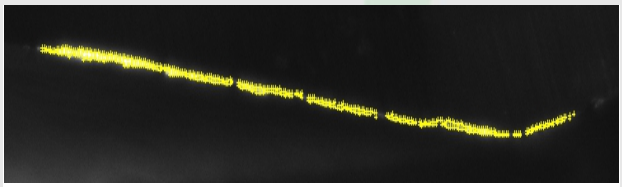
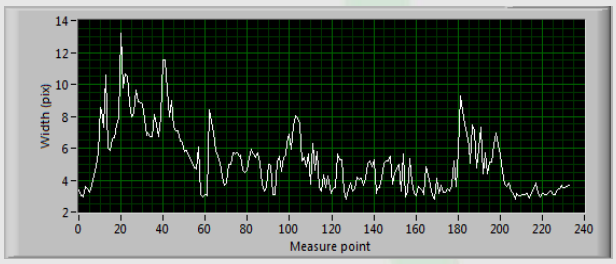


Image 10: result of the edge detection algorithm detecting the edges of the damage.



Graph 11: width of the damage in pixels. Measured between the corresponding edges of the damage (yellow crosses).