Needle Tip Quality Inspection

The standards of needles for medical application are very high. A large amount of these needles, particularly with a special shape, are produced with a spark-erosion machine that can produce any shape.
These spark-erosion machines are in principle very precise. Nevertheless, small errors or damages occur during or after the production process. Therefor a quality control is in order. Currently this is still done by hand.

An automated inspection and selection system will not only save on costs, but it can objectively guarantee the right quality.

This publication gives the following results of a needle quality measurement, executed by vision:

1. contour measurements
2. surface quality measurement

Contour Measurements

1. Good cut surface profile

Below is an example of a good cut surface profile.

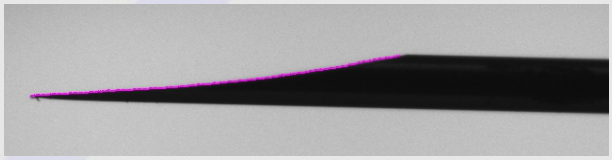

Image 1: Side view of a well produced needle, in purple the detected contour points of the cut surface.

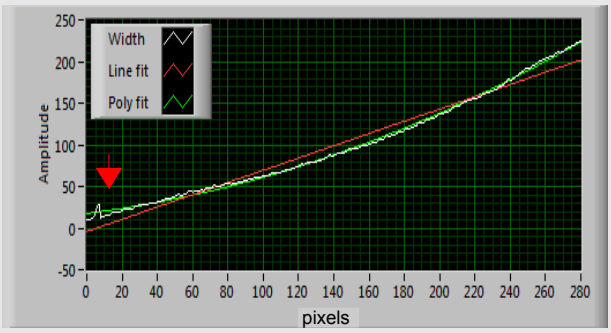

Image 2: Width of the needle (white). Linear fit in red and a parabolic fit in green.

The cut surface isn't straight but curved. The left image (image 2) shows the contour pints in purple. Image 1 displays the calculated distance ('width') between the cut surface and the bottom of the needle. The small spike is the graphical representation of a dust particle at the bottom of the needle. Measurements are displayed in pixels, with 1 pixel representing 3 micrometer vertically and 5 micrometer horizontally. (dust particle is 36 micron high and 60 micron wide)

2. Rejection cut surface profile

Here the tip of the needle is crooked (damage = rejection).
The upper graph (image 4) shows both the bent tip as well as the small dust particle (red arrow). The lower graph shows the difference between the points and both fits. The curve of the tip is more than 150 micron high and 150 micron wide. The dust particle is 24 micron high.

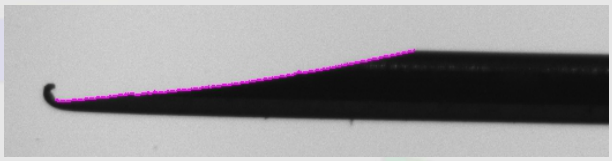

Image 3: needle with bent tip, the fit is executed over the purple dots on the 'cut surface'.

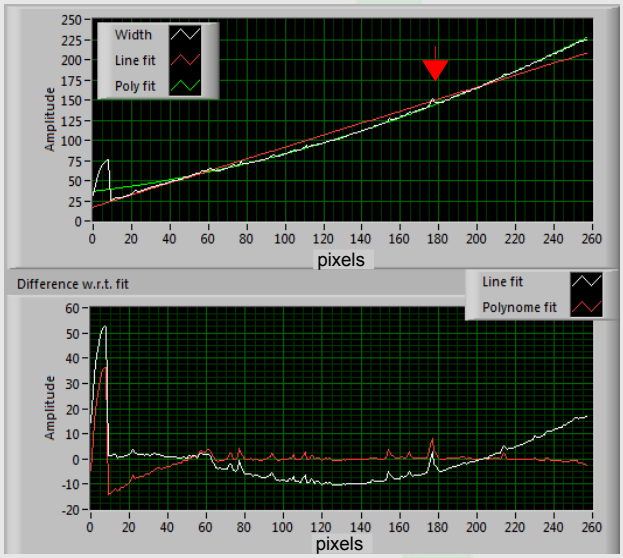

Image 4: Above the measured points are displayed in white above. The red line indicated the linear fit and the green line indicates a polynomial fit. Below displays the difference between measured points and both fits.

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3. Rejection Cut Surface Profile, Poorly Produced

This needle has a poorly produced cut surface with a 'lump' (image 5) with a height of 50 micron and a width of 375 micron. The red arrows represent the position of the dust particles.

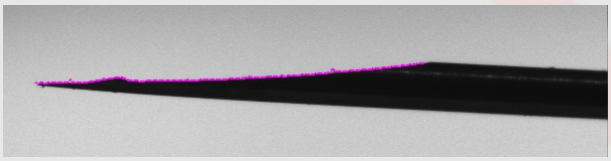

Image 5: Poorly produced needle, 'lump' in cut surface.

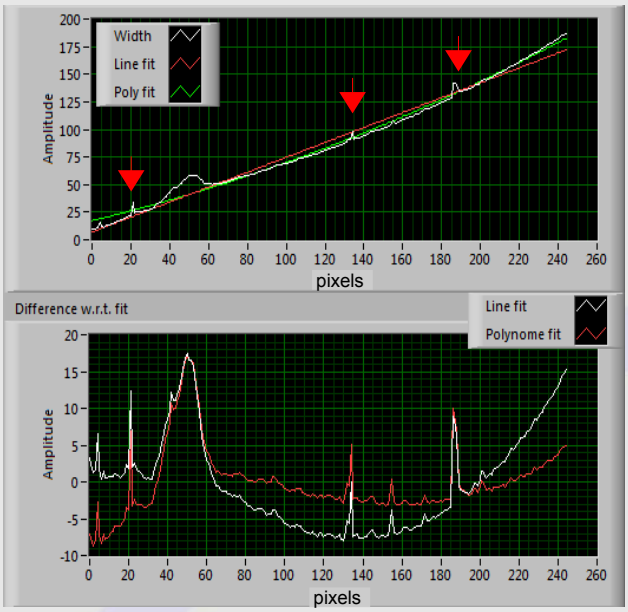

Image 6: poorly produced needle.

The bottom graph displays (image 6) the difference between the measured contour points of the cut surface, the fitted linear curve (white) and the polynomial curve (red).

Surface Quality Measurement

Through application of the right lighting damages like a bright scratch become apparent (image 7).

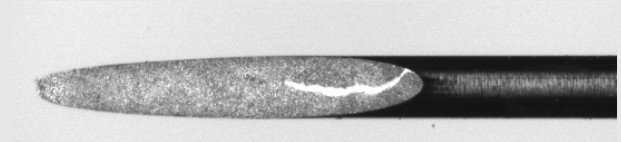

Image 7: Right lighting brightly displays the damage.

Damages can be detected in multiple ways:

1. Local intensity detection gives the result displayed in image 8.
   The small red dots indicate detection noise and can be filtered out. This results in a clear damage, of which we can determine the length, width and area.

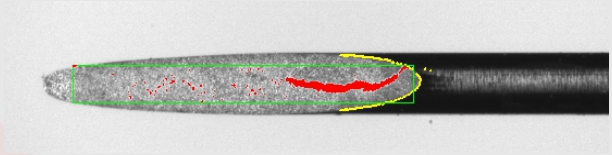

Image 8: Local intensity detection. Damage is indicated in red.

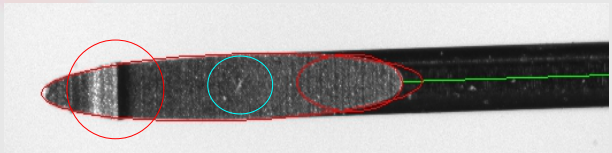

Image 9: : Dynamic contrast measurements detect the irregularities in the cut surface.

2. Dynamic contrast measurements, like applied on the needle with the poorly produced cut surface, image 9. After detection, the length, width and area of the damage can be determined. Results are shown in image 10. The dynamic contrast measurement also detects the damaged tip.

Image10: Result of the dynamic contrast measurement.

If the damage exceeds the rejection limit, the product is rejected.

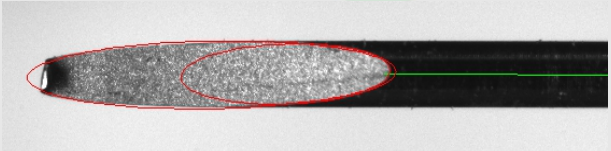

Image 11: The two ellipse fits and the middle line of the shaft.

An extra contour measurement calculates the deviation with regard to an ellipse. This gives very accurate geometrical results, as displayed with the bent needle tip in image 11.