Application Note
for Industry

Inspecting Edge Breaks / Edge Radius

with NOVACAM™ EDGEINSPECT™ 3D Metrology System

Keywords: sharpness inspection, cutting edge, cutting tool geometry, chamfer, bevel, notch, fillet, thread mill, boring bar, blade, cutter, reamer, PCB drill bit, nose radius, corner radius, leading edge radius, cutting tool, cutting wedge, high-precision machining, industrial inspection, GD&T, MRO, non-contact profilometry, 3D metrology, optical profilometry, hard-to-reach surfaces, high-aspect ratio imaging, CMM, CNC

Introduction

With an increasingly competitive manufacturing market, edge finishing processes are a crucial component of manufacturer guarantees. Whether it is for deburring or deflashing, or conversely ensuring edge sharpness, having a solid quality assurance method can add tremendous value to a product.

NOVACAM EDGEINSPECT system acquires and analyzes edge properties and, as needed, detects burrs with micrometer precision. The system's design has been driven by the objective of providing versatility, automation, and speed in its ability to acquire non-contact ultra-high-definition readings of varied geometries of machined parts.

The Power of Analysis

Within precision manufacturing industries, characterizing edge finishes is a universal process. Many edge characteristics may need to be measured. Whether ensuring the sharpness of edges, for example in scanning the tools used in machining or milling processes, or looking for burrs and defects, edge analysis is of paramount importance.

In the case of burr removal, the EDGEINSPECT system automates burr property inspection and confirms whether the part meets design requirements. This then indicates if any finish processing is required.

For ensuring edge sharpness, the EDGEINSPECT system can confirm that the cutting edge of machining tools is razor sharp—either at the manufacturing stage, during routine inspection, or during tool reconditioning. In turn, this prevents discrepancies in part machining.

Edge characterization and defect detection is also made easy with the EDGEINSPECT system 3D visualization capabilities (Figure 1).

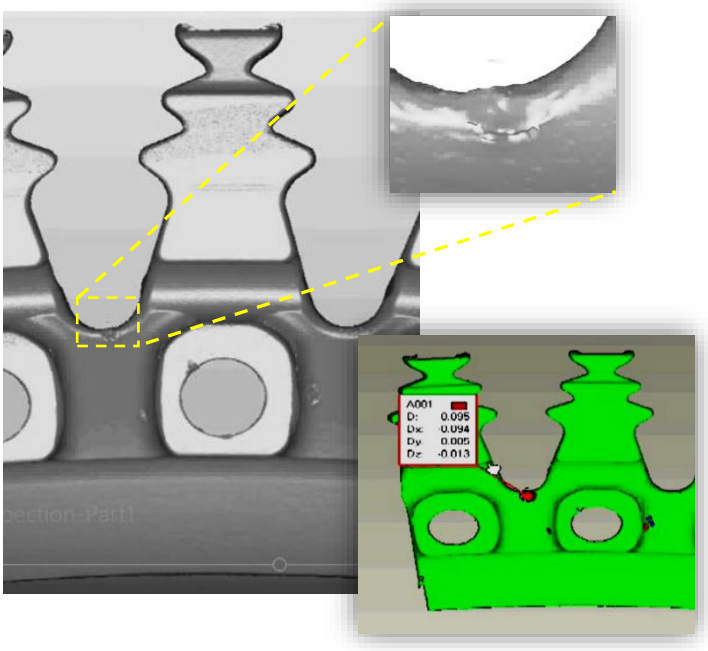

Figure 1: A chamfer defect is detected on the fir-tree base of a jet engine turbine

How It Works

Based on low-coherence interferometry technology, the EDGEINSPECT system acquires high-precision 3D topography of surfaces in a point-by-point manner, at a rate of up to 100,000 3D points per second. The resulting 3D point cloud gives micron-precision geometry of edges, which can be analyzed according to GD&T criteria set by the user.

No Matter What the Geometry

The EDGEINSPECT system offers an automated metrological method that scans and characterizes edges on just about any geometry.

The scanner can cover a surface area as large as can be reached by robotic arms. It can be angled to suit any type of edge: round holes, straight edges, cross holes, inside or outside edges, etc. The process enables characterization of any number of edge specifications, including burr detection, edge break requirements, angle measurements, as well as matching edge radiuses or checking tolerances after burr removal—all with micron precision.

Depending on the application needs, the scanner can be mounted on a stage, on a robotic arm tool exchanger, or on a rotating arm to enter deep cavities. The part itself can also be mounted on a rotating stage.

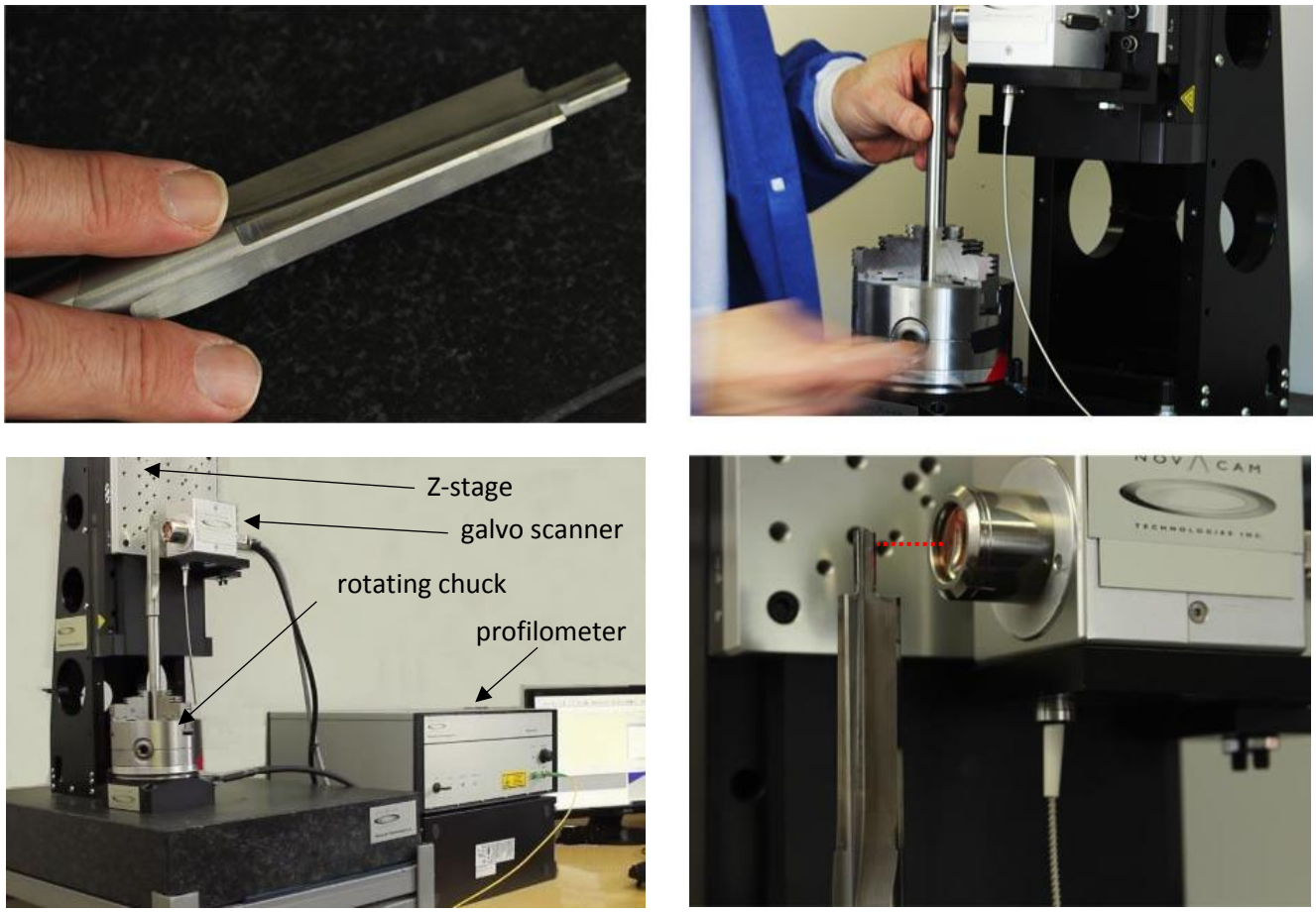

Figure 2: A machining drill bit (top left) is mounted on rotating chuck (top right). The tool is scanned by the galvo scanner, which in this configuration is mounted on a Z-stage (bottom left and right). The optical signals are processed by the profilometer.

The EDGEINSPECT system provides the latitude needed to acquire almost any geometry in a single scanning sequence—no need for composite imagery. Moreover, scanning sequences can be automated and replicated at a rate of up to 100,000 points per second. In other words, a part as large as your hand can be completely scanned and rendered within a few minutes.

3D Metrology – High Speed and Automated

Thanks to its high scanning rate, the EDGEINSPECT system lends itself to high-throughput applications. The data collected by its optical scanner passes through an optical fiber, which can be hundreds of meters long, to the profilometer. The 3D point cloud is fed in real time to the accompanying metrology software (e.g., PolyWorks Inspector™) on a PC.

At this point, several data viewing options are available: 3D model, comparison to CAD model, deviation maps, as well as exportable reports. All dimensional and roughness data is captured down to the micrometer. Any sharp edges, cracks, scratches, dings, or defects the user deems important are detected automatically based on user-defined dimensions and tolerances.

The accompanying metrology software provides several automation options such as pattern recognition and pass/fail reporting.

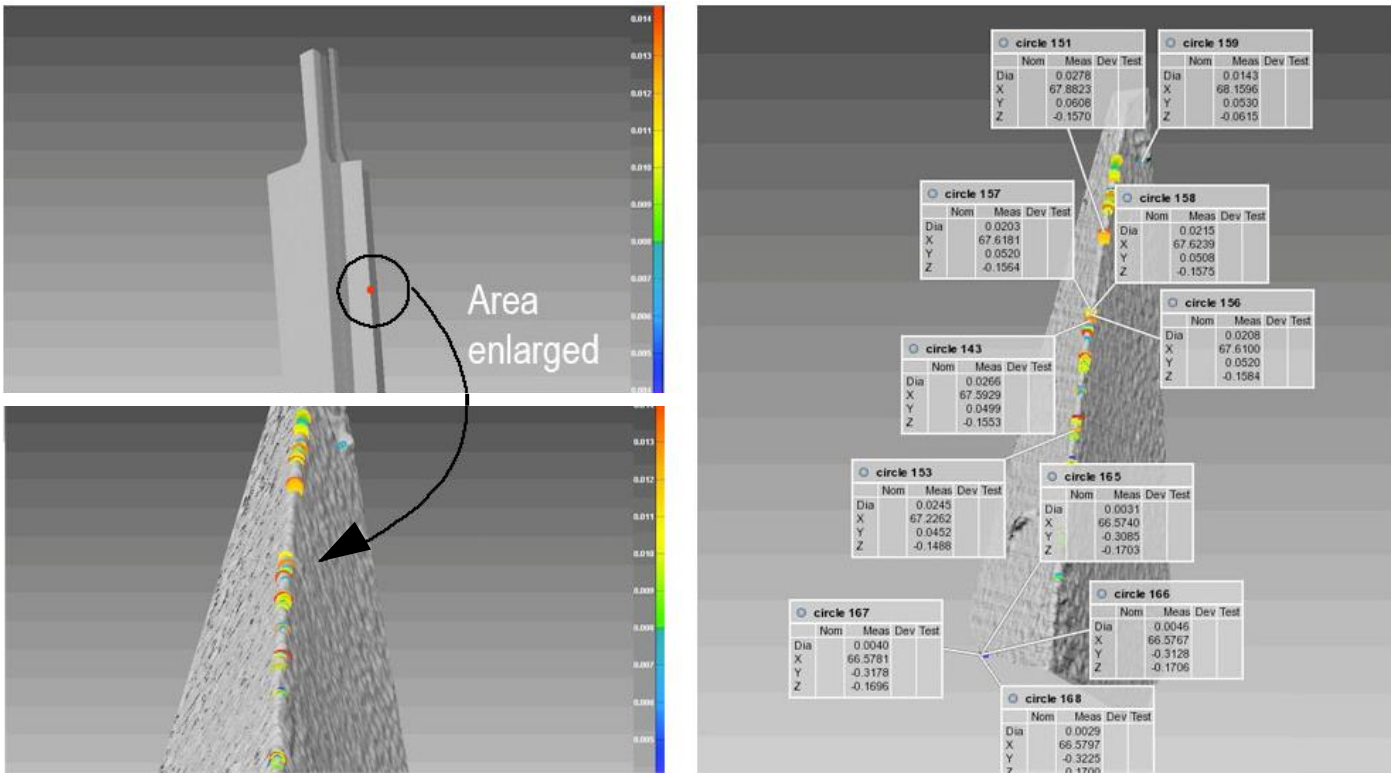

Figure 3: Users can zoom from an on-screen rendering of the drill bit (top left) into the edge area selected for analysis. The enlarged edge segment (bottom left) shows a colour-coded deviation map of the edge sharpness. On this micron-precision deviation map, the user may choose to view edge radii measurements at various points of analysis (right). The measurement units are user configurable.

Common Applications

Cutting tools, before and after treatments, automotive parts, aerospace parts, hydraulic systems, machining tool fabrication, sheet metal parts, machine tool maintenance, burr detection, chamfered edges, sharp edge testing, milling parts, spindle finishing, bearings, tubes, needles, …

System parameters for edge break / edge radius inspection	
Scanning depth range	5 mm (0.2”)
Lateral resolution (light spot size)	Probes with higher resolution to be used, ranging from 5 to 15 µm (≈200 to 600 µin) FWHM (full width half max)
Standoff distance	3 to 20 mm (0.14” to 0.79”)
Wavelength	1310 nm
Axial resolution	< 1 µm (39 µin.)
Distance of probe on inspection station from the interferometer	Up to 10 m (longer available as option)

Conclusion

The EDGEINSPECT system helps manufacturers ensure quality at every step of edge finishing. Measuring edge sharpness, matching edge radii, matching tolerances, verifying edge break requirements, checking alignment, measuring chamfers, and much more can be achieved with the system. Its powerful analysis and measurement capabilities are fast, precise, automatable, flexible, and easy to interpret.

Novacam encourages technicians and engineers in charge of edge inspection to contact us to discuss your applications and particular challenges.

EDGEINSPECT™ system components

Component	Physical aspect	Deployment area
MICROCAM™-3D or 4D interferometer	19” rack-mountable instrument	plant floor / control room
computer workstation	mini desktop-size PC or laptop	plant floor / control room
galvo scanner	surface-scanning galvanometer probe*	on lab inspection stations or on the plant floor as: - robot end-effectors - 3D inspection instruments in automated assembly lines - 3D-vision components in hand-held inspection tools

- Detailed technical specifications on the system are available upon request.
- For edge inspection inside hard-to-reach spaces (e.g., inside bores in valve bodies), rotational probes with diameters as small as 0.5 mm (0.02”) are available.

Watch a video on the EDGEINSPECT system here https://www.novacam.com/resources/novacam-metrology-videos/edge-radius-measurement-video/.

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