

# Crack detection and evaluation

Crack detection using non-destructive X-ray computed tomography (CT) is one of the key capabilities that make the technique useful for industrial applications. The presence of cracks or planar flaws, such as delaminations in engineering components, are a major problem for the continued performance of critical systems in the energy, aerospace, and other industries. Cracks in structural components can lead to system failures, downtime, high repair costs, and even loss of life. Many NDT tools are available for crack detection, and CT is increasingly used for this purpose due to its high sensitivity. It works on all material types and allows full characterization of the crack location and extent in the sample, providing spatial context and quantitative information.

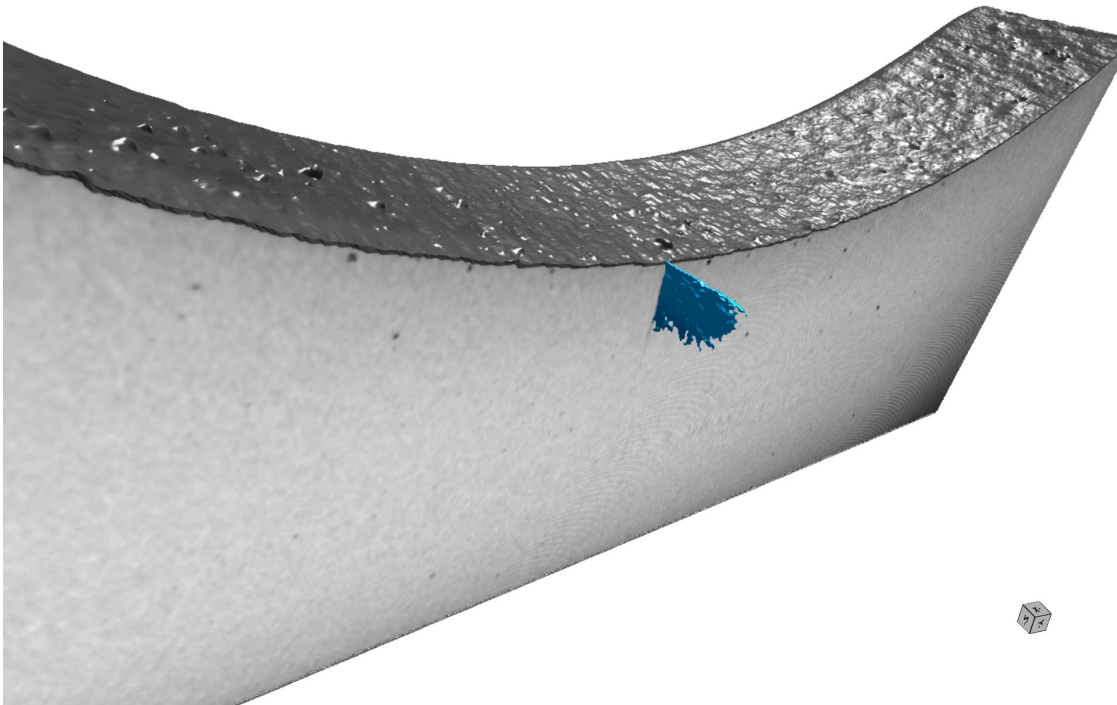
# Requirements

A high-quality CT scan of the part, typically using a laboratory X-ray micro-CT instrument. Since cracks may be very narrow, the best possible voxel size is needed with good contrast, typically obtained from high-end commercial instruments. Large components might require close-up scans of specific regions of high risk, and the method is ideally complemented with other tools to provide holistic inspection. Ideally the scan is performed with the sample at an angle to minimize image artifacts on the crack.

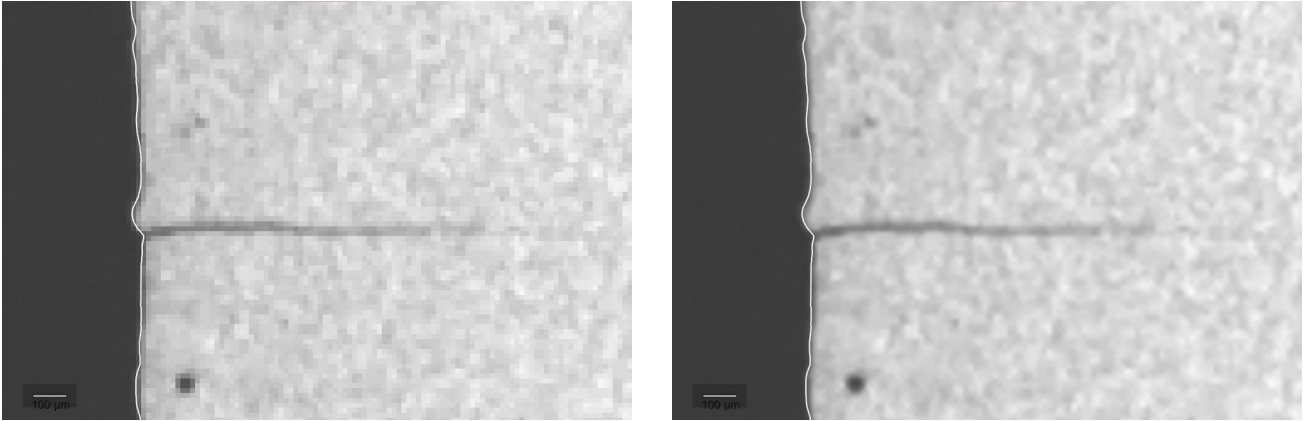
Image analysis is fully digital, and Dragonfly 3D World can import standard volume data types from most commercial CT systems. Although the actual part is not needed, the voxel size must be known. Typical datasets are 16-bit TIFF image stacks representing the full volume.

## Typical outputs

- Crack identification using 2D cross sectional images.
- 3D crack visualization.
- Crack length and width measurements.
- Surface roughness evaluations before and after fatigue tests. The example below is from research involving such a study to identify the “killer notches” on the surface initiating fatigue cracks. Publication available at: <https://doi.org/10.1016/j.addma.2020.101424>



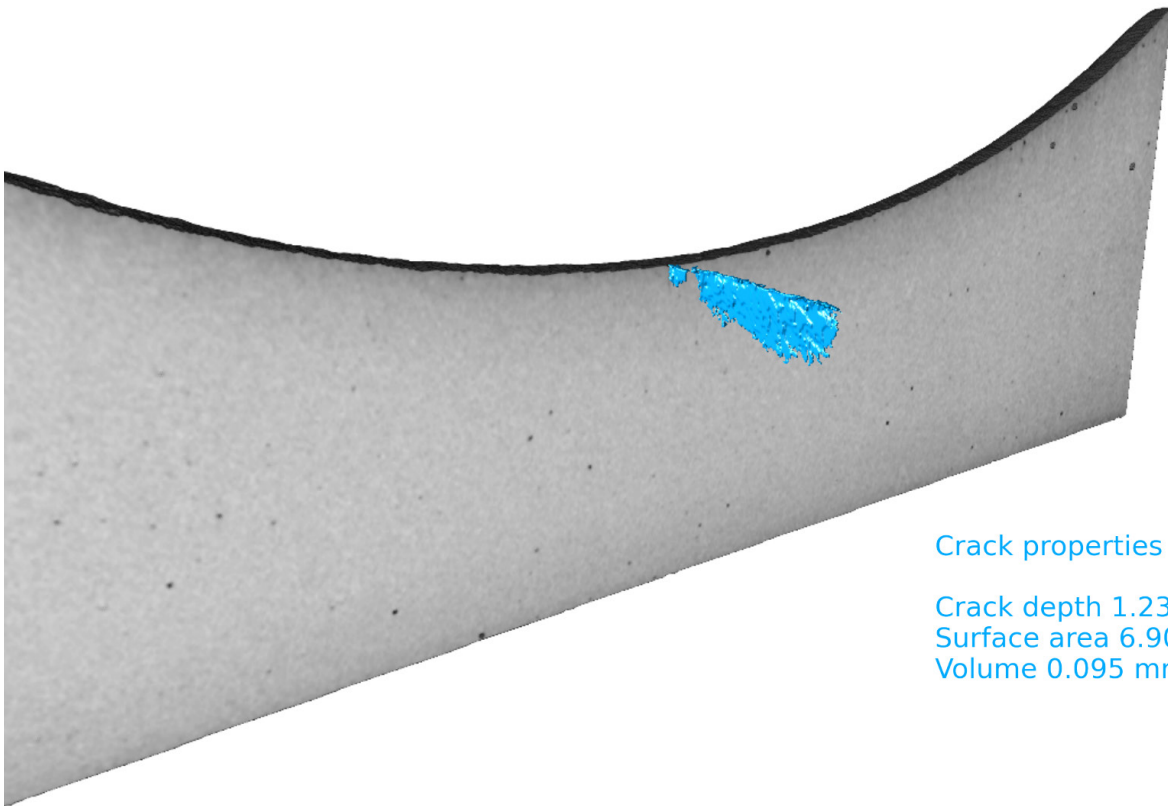
*Narrow crack identification from X-ray computed tomography scan data even near the voxel size, 3D rendering with crack in blue and part cropped to expose half of the crack width.*



Crack detection and visualization requires sub-voxel interpolation – this improves the detection of narrow features near the voxel size. In the cross-sectional CT image on the left is the raw data showing voxels and to the right is the interpolated view, with white line in both cases representing a sub-voxel interpolated surface. Also visible in this cross-section is a pore near the surface, the process also improves pore detection.

PD: 10,895 mm

W: 10 506 C: 39 929



Crack properties

Crack depth 1.23 mm  
Surface area 6.906 mm<sup>2</sup>  
Volume 0.095 mm<sup>3</sup>



Measurement of the dimensions of a crack is possible with simple metrics such as the maximum depth from the surface. Other properties such as crack surface area and volume are easily obtained.

Crack identification is applicable to:

- Metal components
- Composites
- Plastic parts
- Ceramic parts
- Other materials
- New parts for checking manufacturing process
- Used parts for checking wear and process induced damage.

## Advanced

The above examples show the clarity and ease of identification of cracks using CT. An important factor is image quality, with high quality required for reliable crack detection. Image processing steps can reduce noise and improve the contrast using specialized tools, which are not described here but are included in the Dragonfly 3D World image processing toolbox. Deep learning tools can also be optimized and fine-tuned to your application making the process more reliable, using limited training data.

## The benefits

The benefits of this for your process is knowledge of the quality of your parts, using a reliable software for data analysis. The workflows in Dragonfly 3D World are fully customizable and open to the user, there are no hidden algorithms or question marks surrounding data analysis. Customization and reporting tools allow faster and better decisions to be made for improving manufacturing processes and in quality control and qualification efforts. Unlock a new world of quality control in your industrial inspection using Dragonfly 3D World!

For a video workflow demonstration of the above case:  
<https://www.youtube.com/watch?v=648R-rjHr2Q>



Dragonfly - a brand of Comet  
Comet Technologies Canada Inc.  
460, rue Ste-Catherine Ouest  
Suite 600  
Montréal (Québec)  
Canada H3B 1A7  
🌐 [dragonfly.comet.tech](http://dragonfly.comet.tech)