Wood – the material of the 21st century

Computer Vision in research work in Wood Technology

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Computer Vision

Object

Image acquisition

Interpretation

Result:
it's a car

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Computer Vision Is **Not** Necessarily Machine Learning

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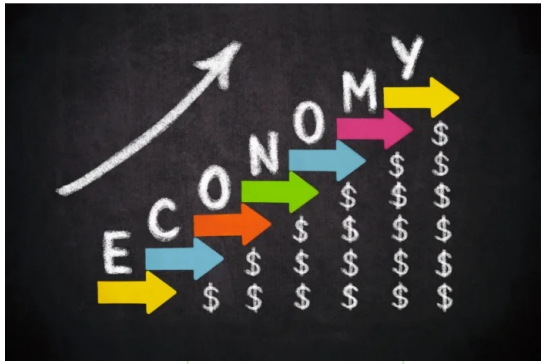
Is machine learning our only option?

When we can't use machine learning:

- lack of large sets of (processed!) data,
- limited computing resources,
- too high preparation cost.



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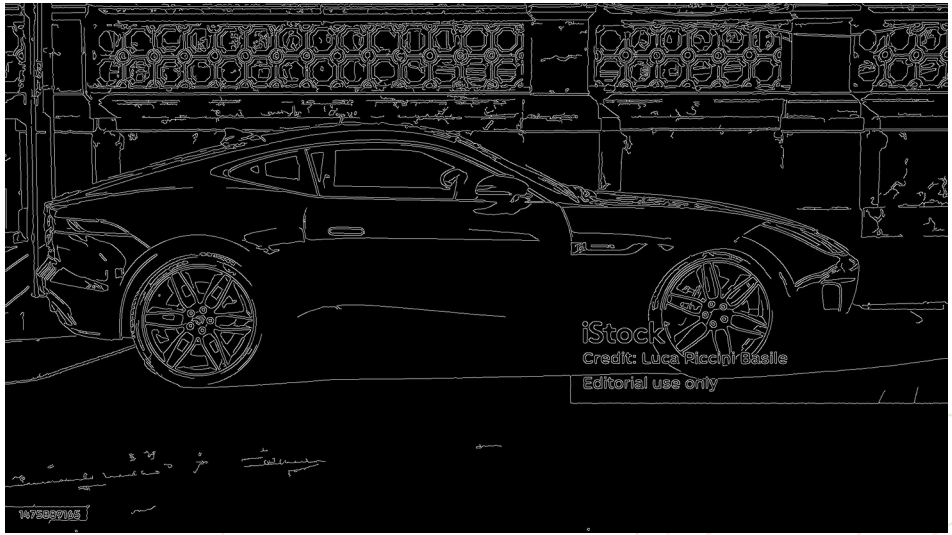
If we can't use machine learning...

OpenCV

- Support for multiple programming languages – OpenCV can be used with languages such as Python, C++, Java, or even MATLAB (via bindings).
- Rich feature set – offers tools for face detection, motion analysis, image segmentation, object recognition, video processing, and many other computer vision tasks.
- Also has machine learning tools.

...and it’s free!

OpenCV: Simple, yet powerful



Canny edge detection.

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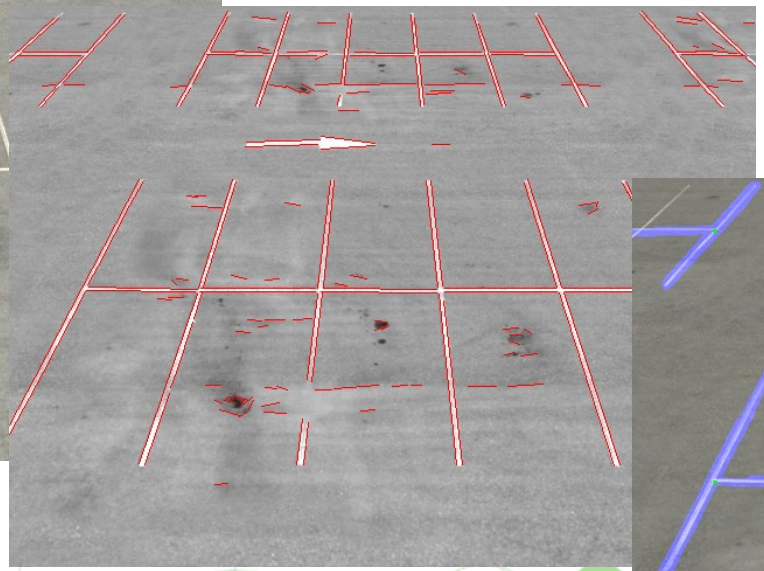
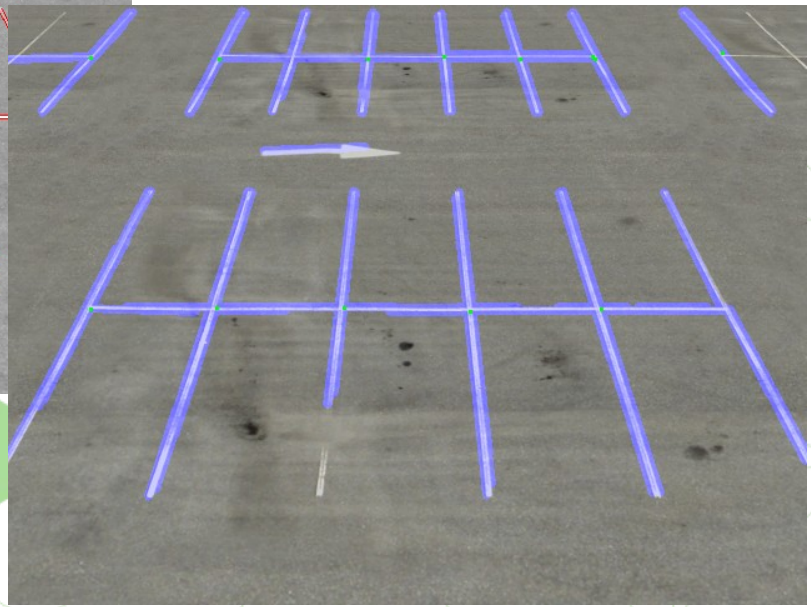
OpenCV: Simple, yet powerful



Lines detection



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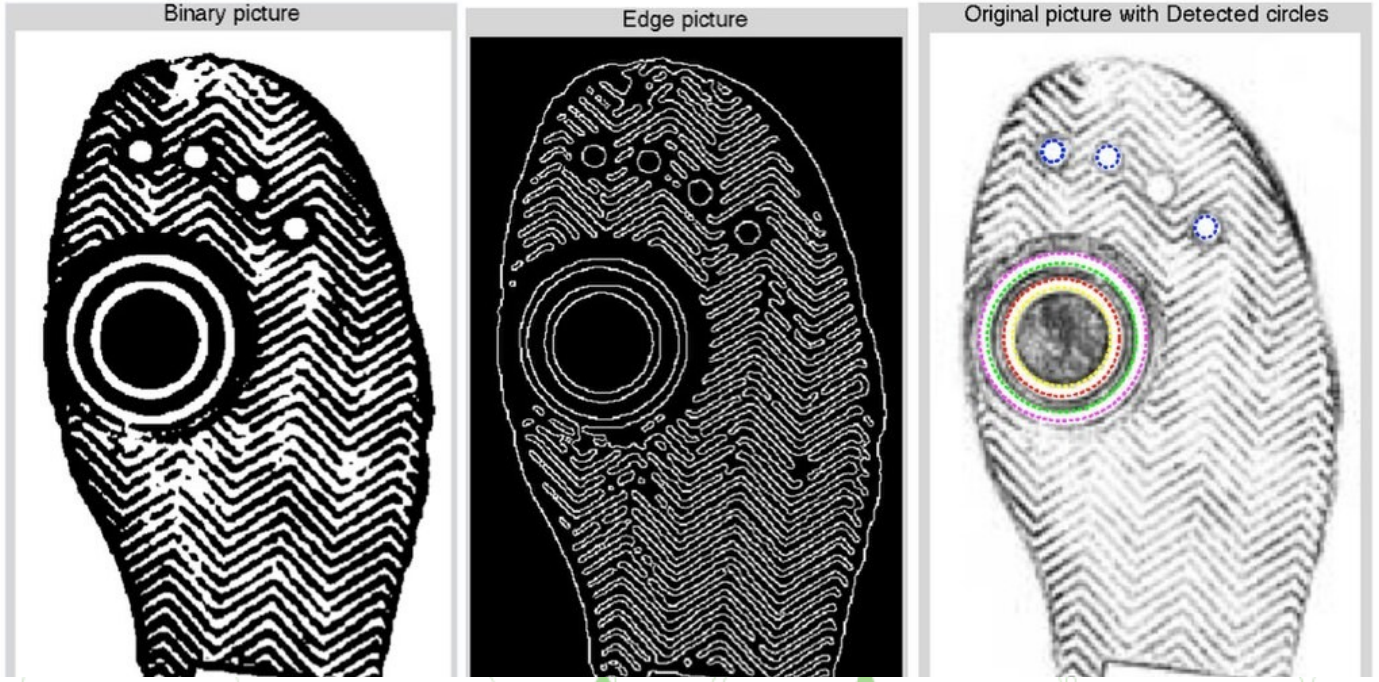
OpenCV: Simple, yet powerful

Circles detection



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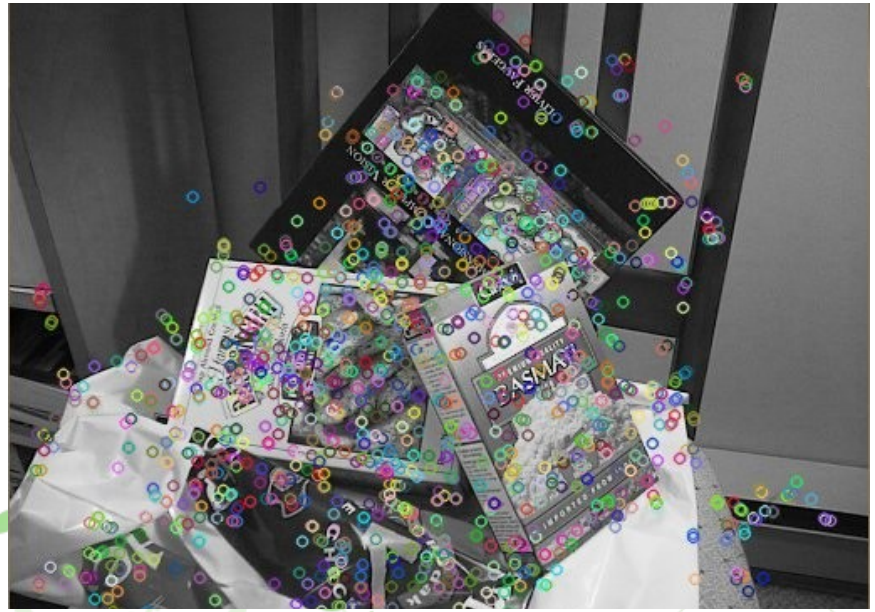
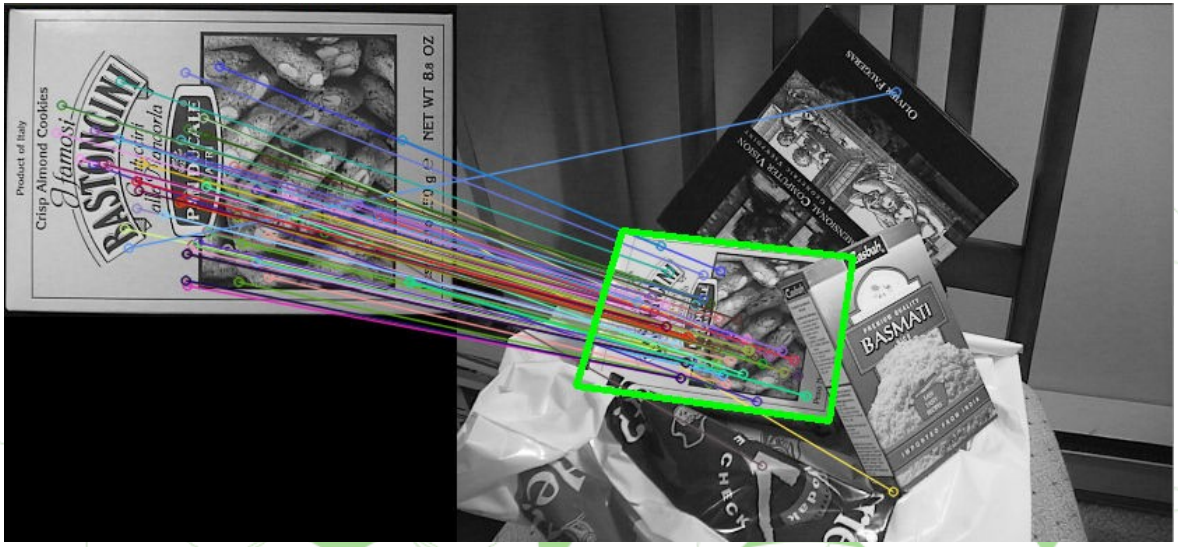
Need more?



Features detection

We can find feature points in one image and match them to others.



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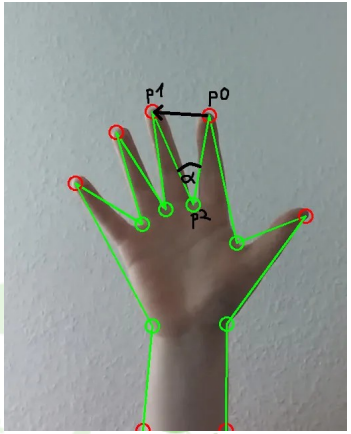
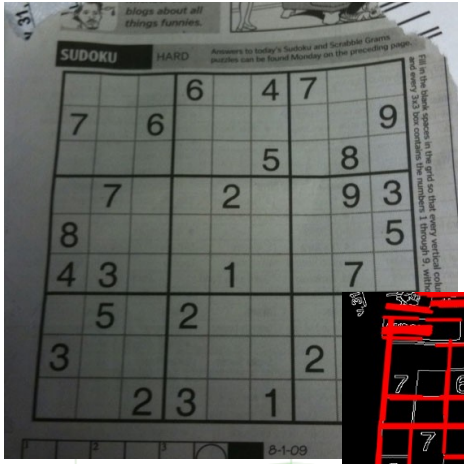
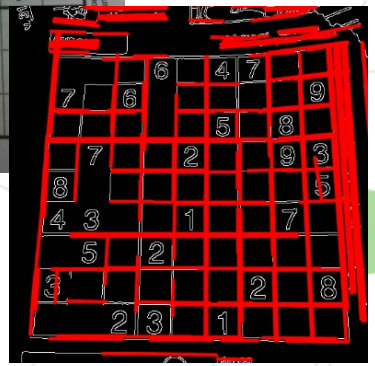
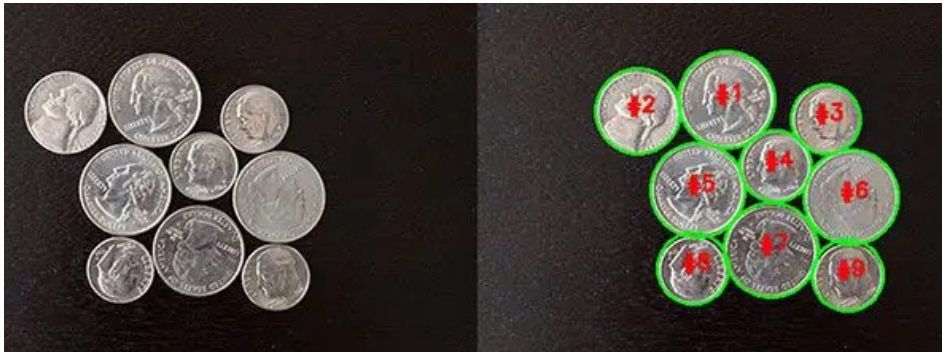
Basic examples

What can computer vision be used for?









All examples are from OpenCV library.

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Drill wear

Król, P. M., & Podziewski, P. (2025)

Drill focus-stacking (DrFS): computer vision toolset for tool wear measurement.

Wood Material Science & Engineering, 1–8.
https://doi.org/10.1080/17480272.2025.2486227

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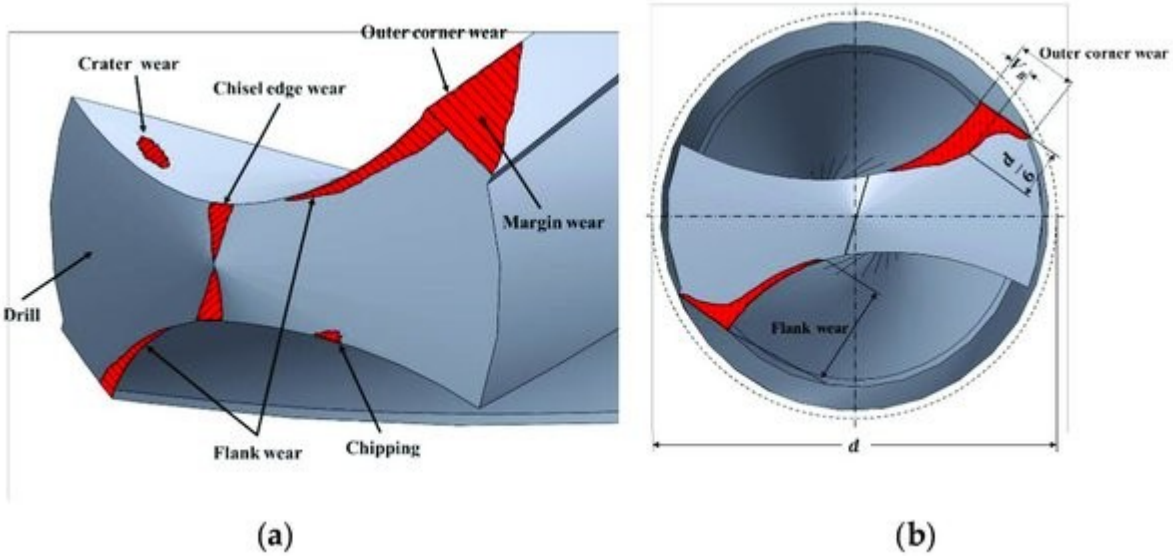
Drill wear

Wear as maximum thickness of FLANK WEAR (image b).



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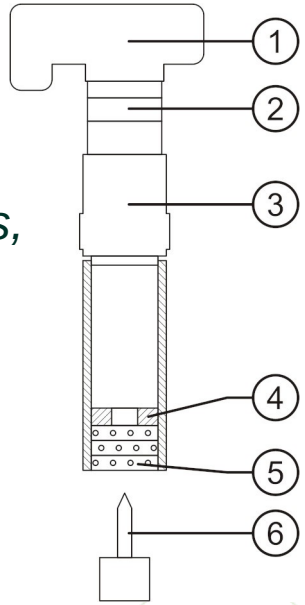
Drill wear

1 – camera,
2 – macro rings,
3 – lens,
4 – light barier,
5 – LED,
6 – drill



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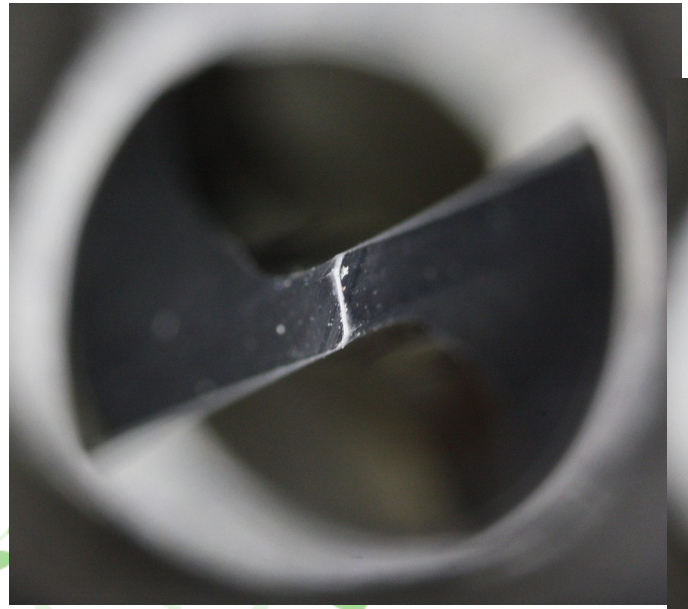
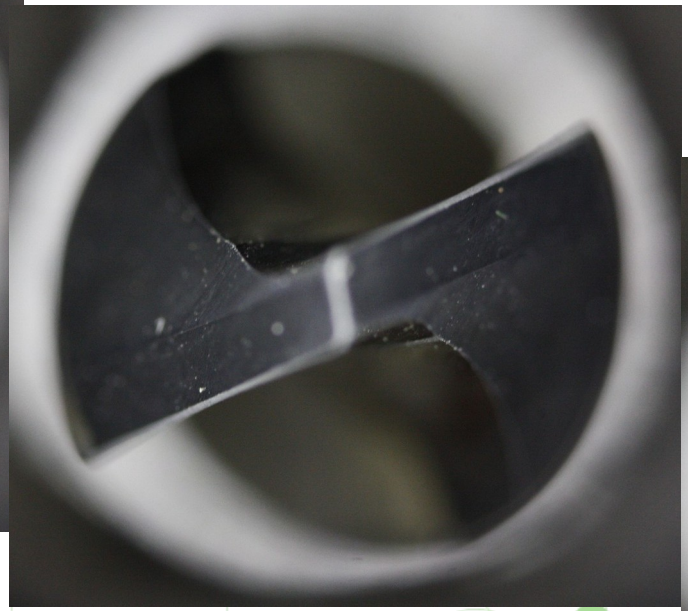
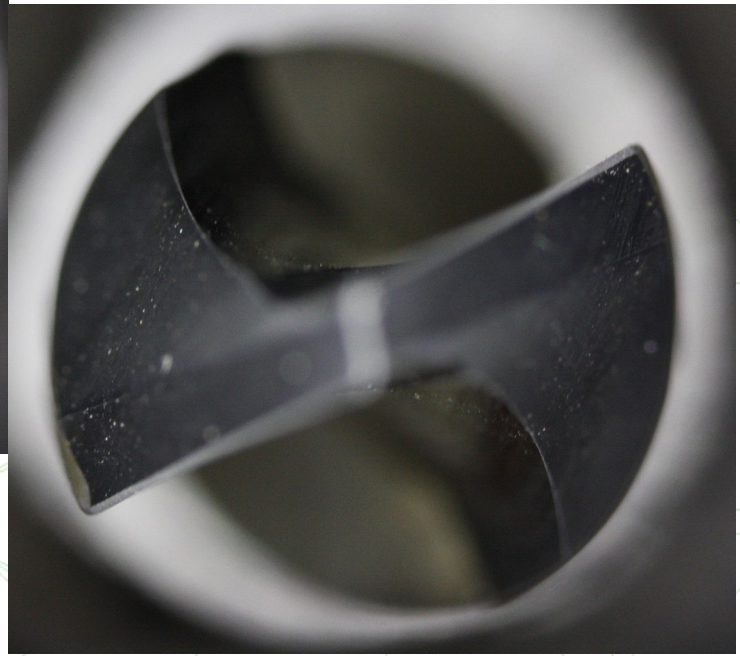
Drill wear







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Drill wear / Focus stacking

Focus stacking
Mixing a series of input photos with a predominance of „sharp” spots.

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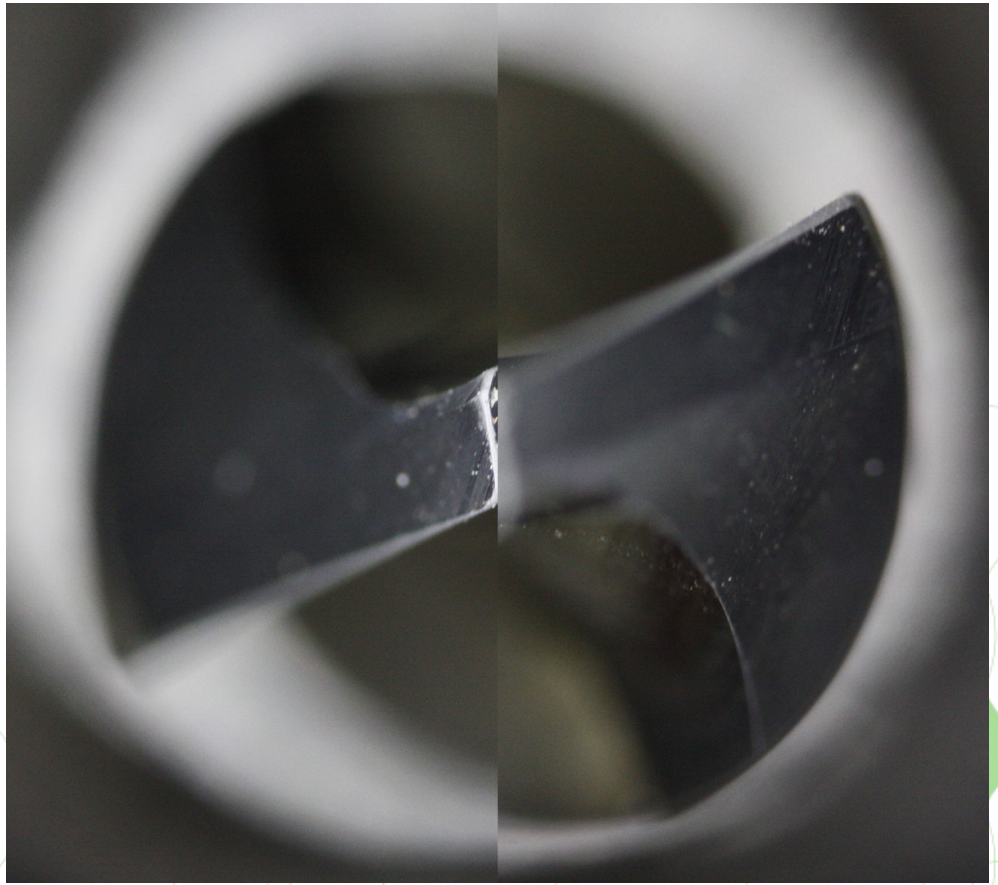
Drill wear

Idea: Instead of “mixing” the photos, let’s take the sharpest parts and put them together.

Problem: photos alignment.



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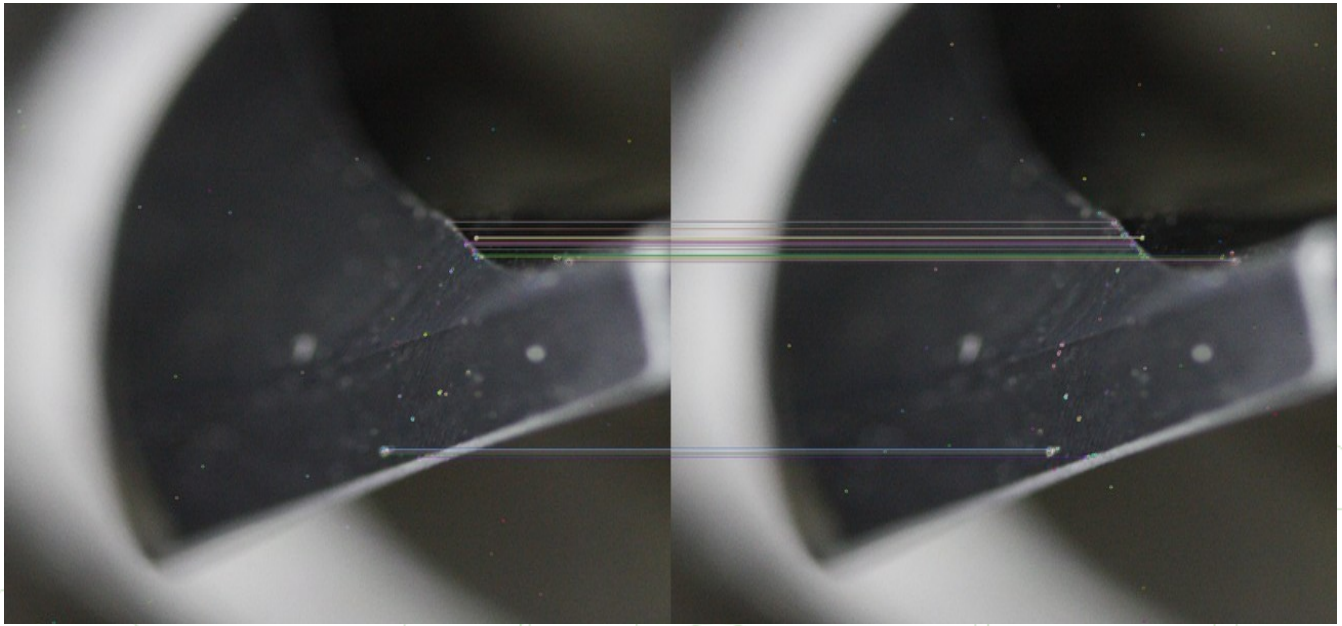
Drill wear / Aligning

Solution: Find characteristic points in both images and match them together.



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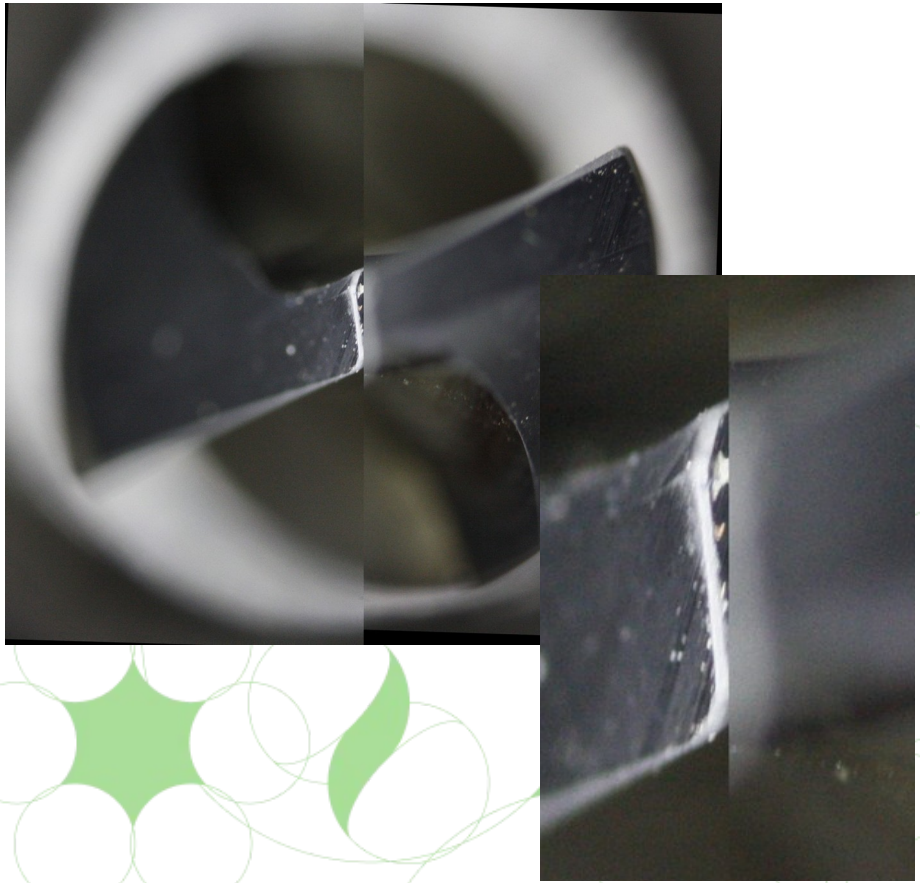
Drill wear / Aligning

Before

After



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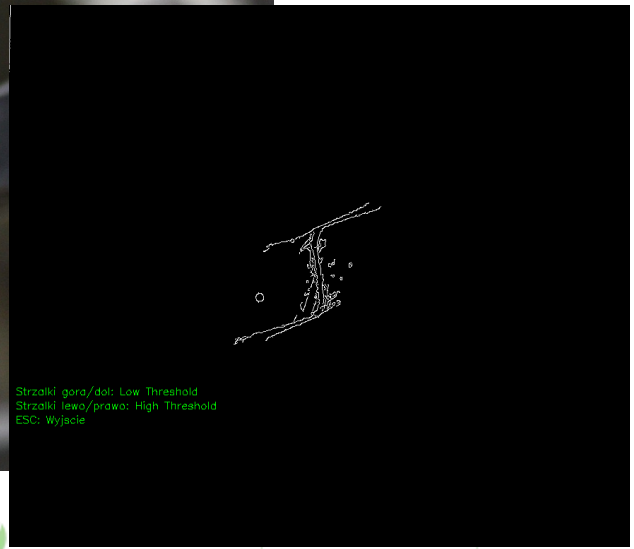
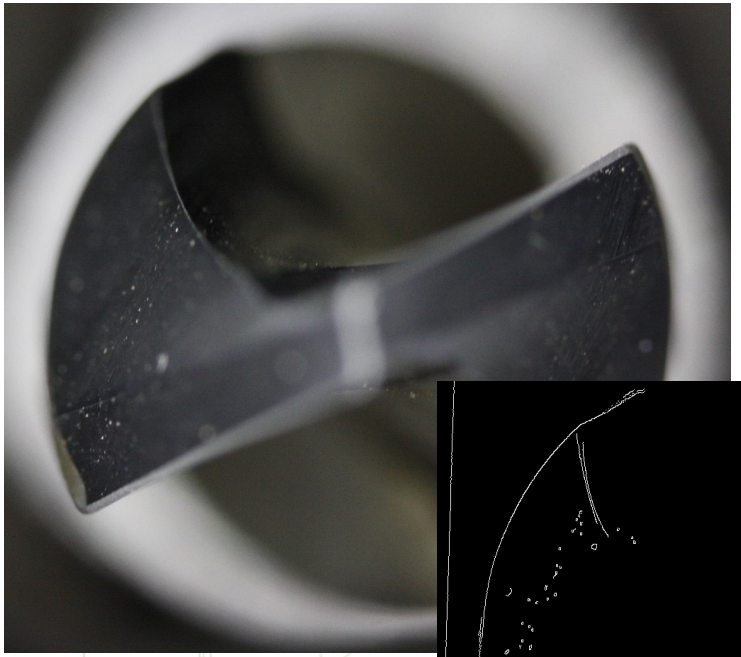
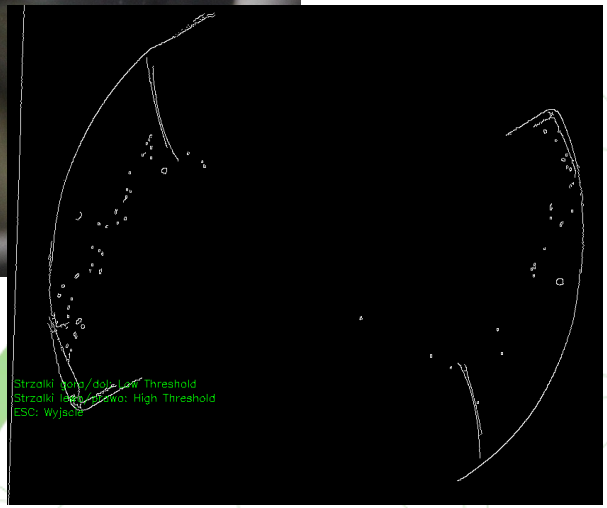
Drill wear / Mosaic-mixing







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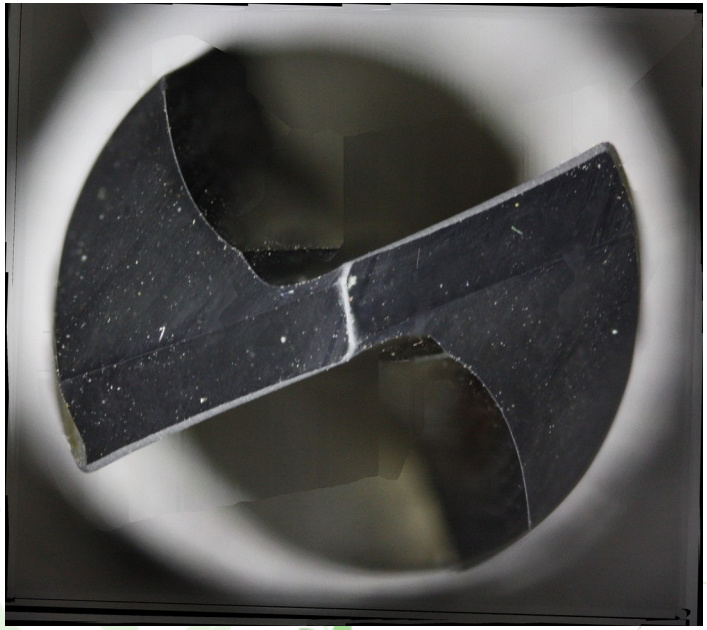
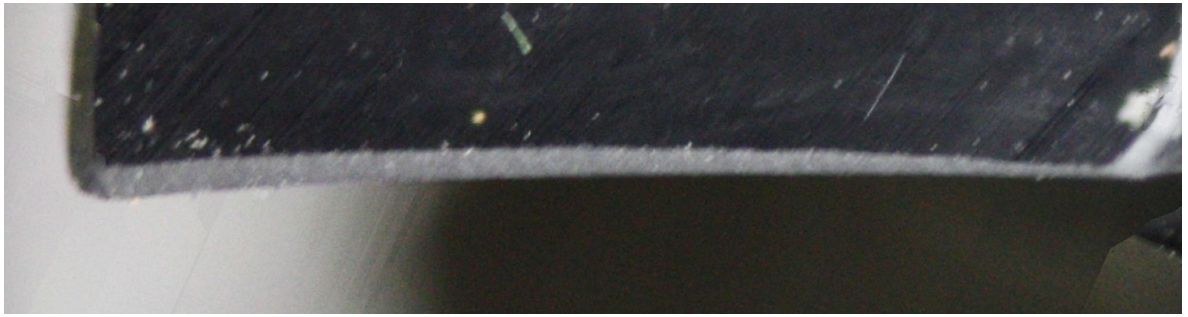
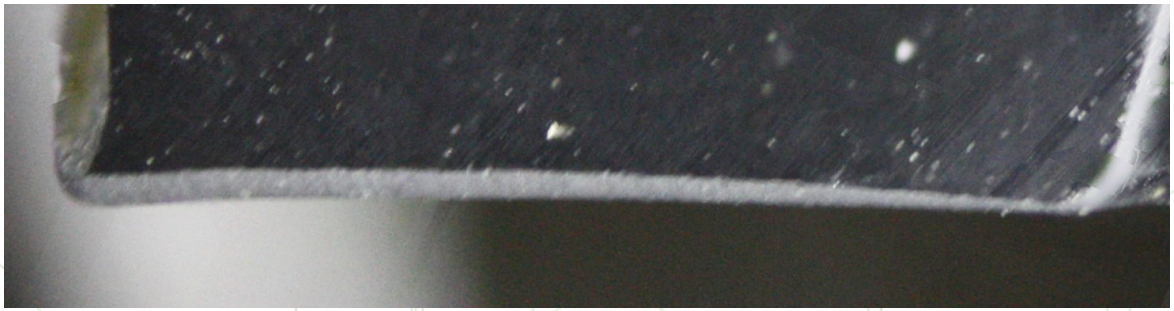
Drill wear / Effect







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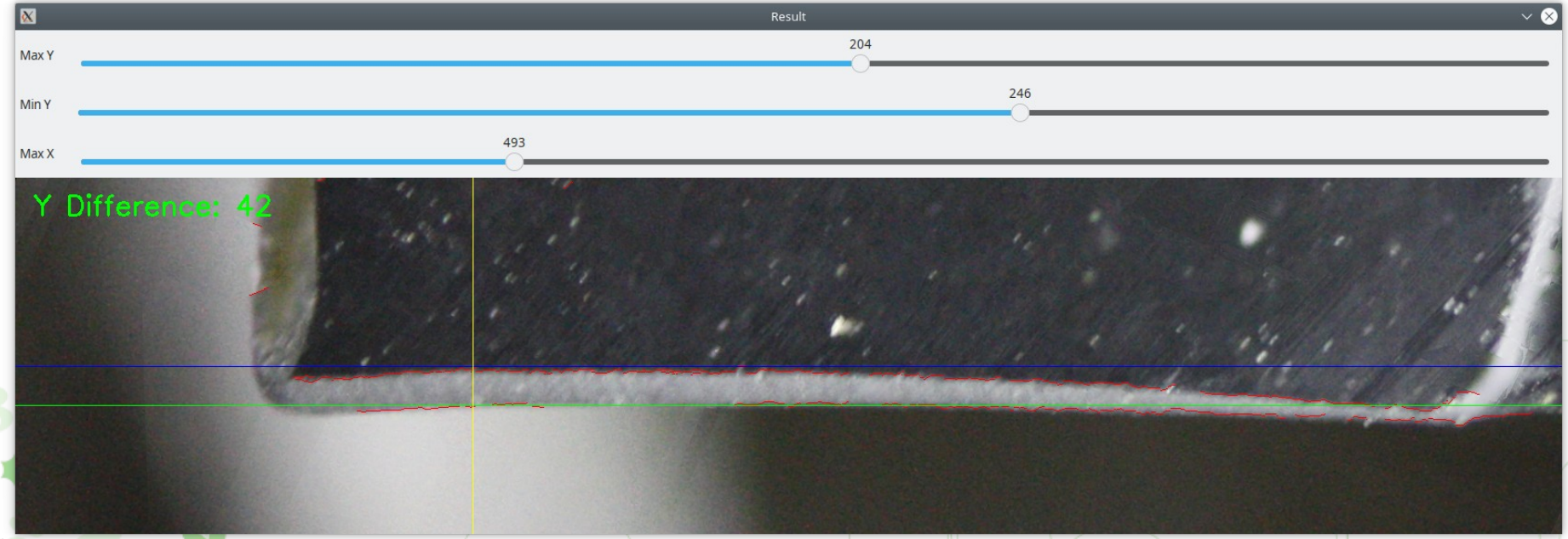
Drill wear / Semi-automatic measurement



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Other examples

Bei et al. 2011: Auto Recognition of Navigation Path for Harvest Robot Based on Machine Vision

Objective: to guide the robot through the orchard.

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Other examples

First step: image binarization



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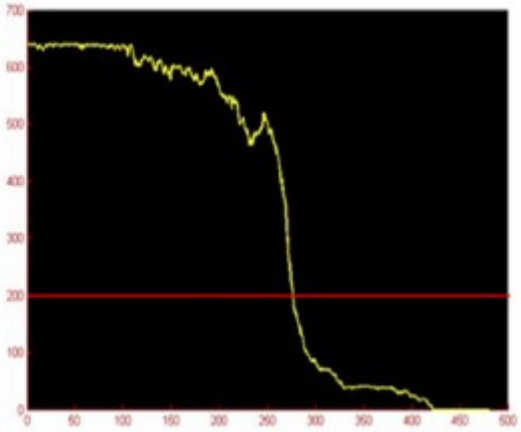
Other examples

Second step: cutting out the part of the image that has the most trunk.



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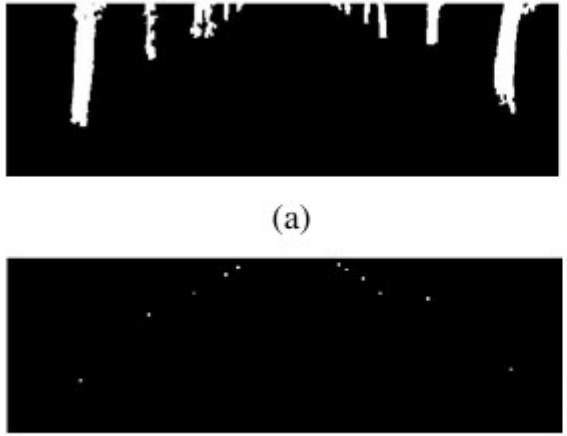
Other examples

Third step: detection of characteristic points (proprietary algorithm)

Fourth step: connecting the detected points with two lines and determining the center line.



(a)

Other examples

Subah et al. 2017: An Interactive Computer Vision System for Tree Ring Analysis. Current Science

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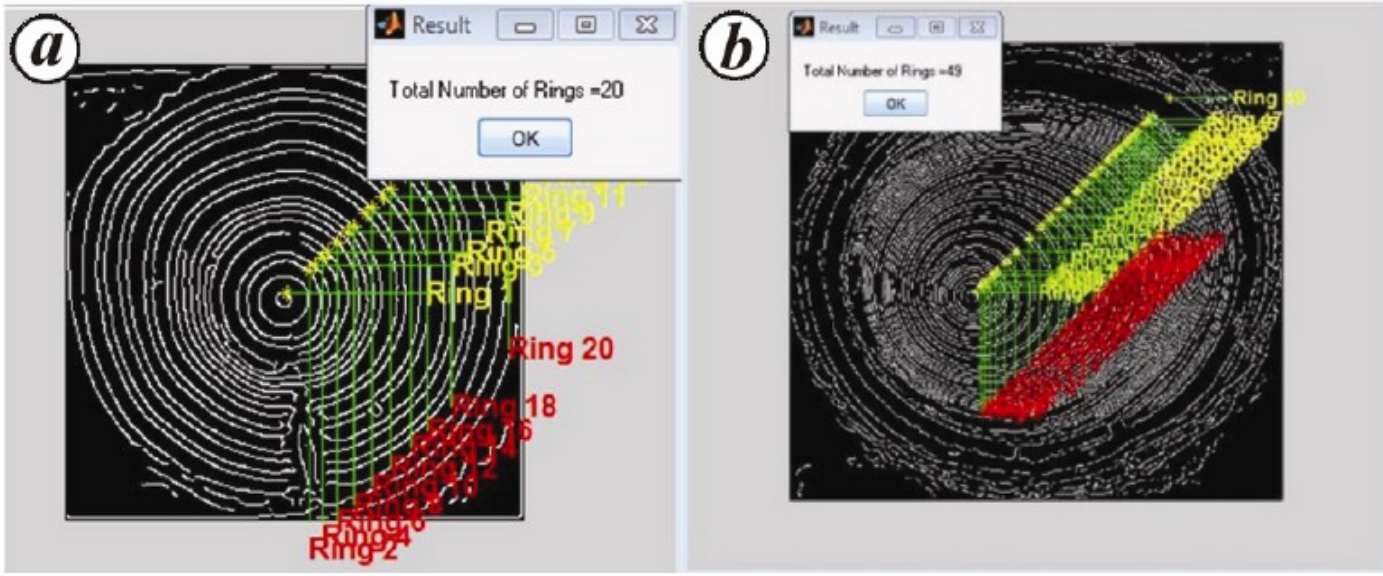
Other examples

Canny + ring „completion”.



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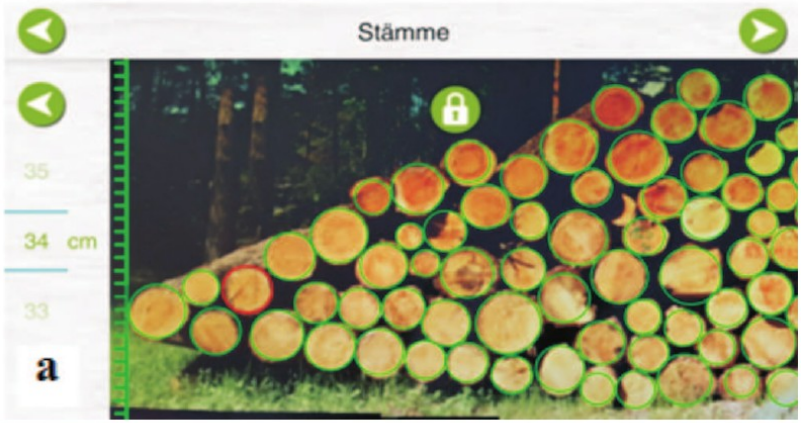
Other examples

Photo-optical measurement of wood in a stack.



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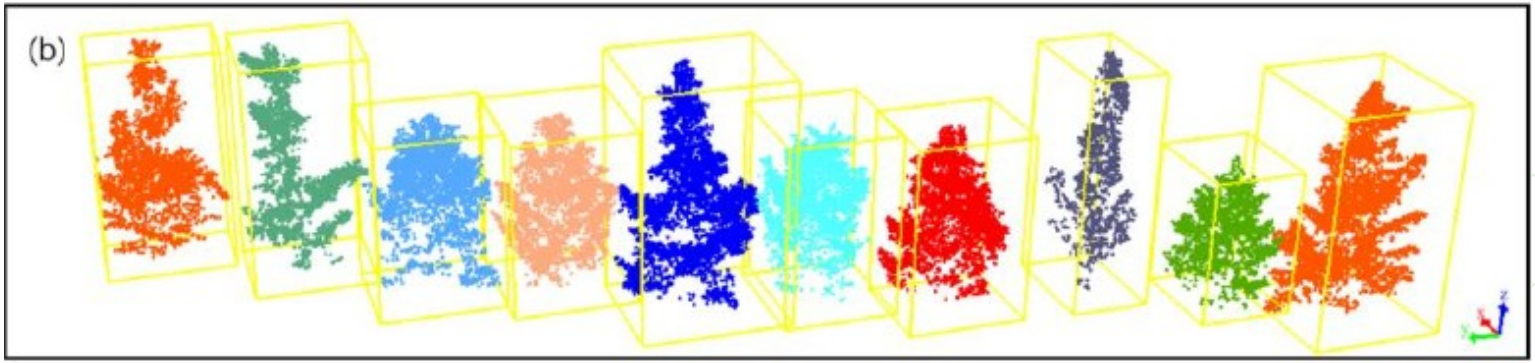
Other examples

Identifying Tree Species Using a LiDAR Scanner



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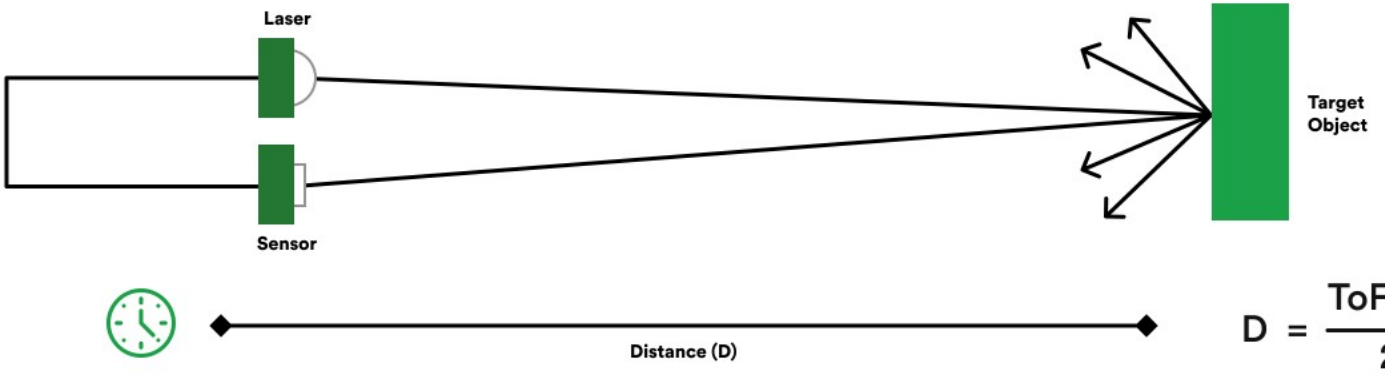
Other examples

How does LiDAR work? (point)



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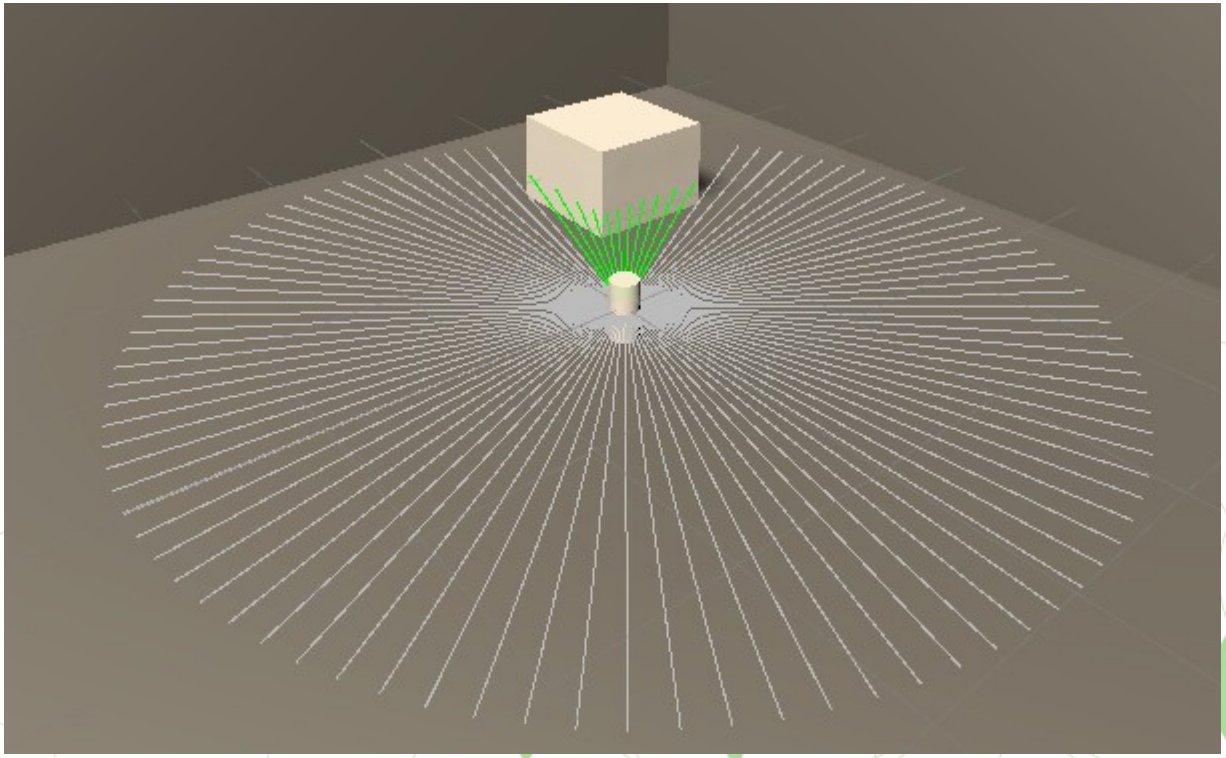
Other examples

How does LiDAR work? (plane)



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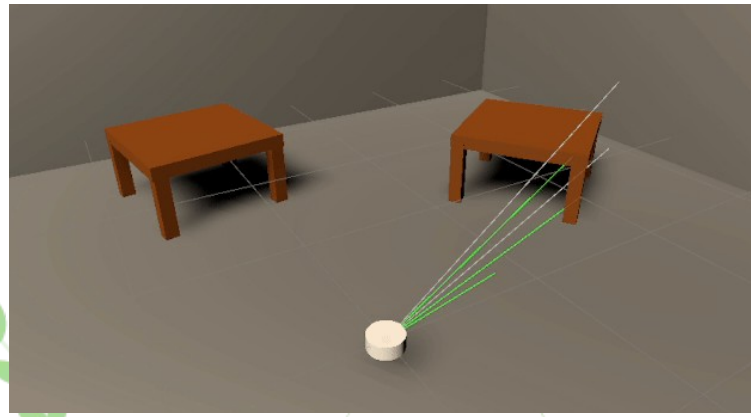
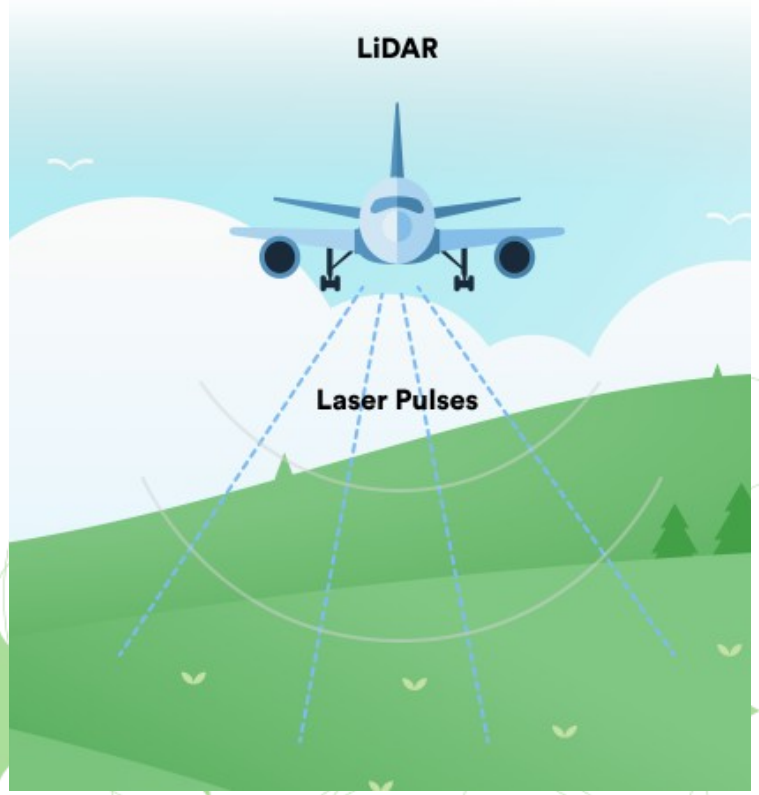
Other examples

How does LiDAR work? (3D area)





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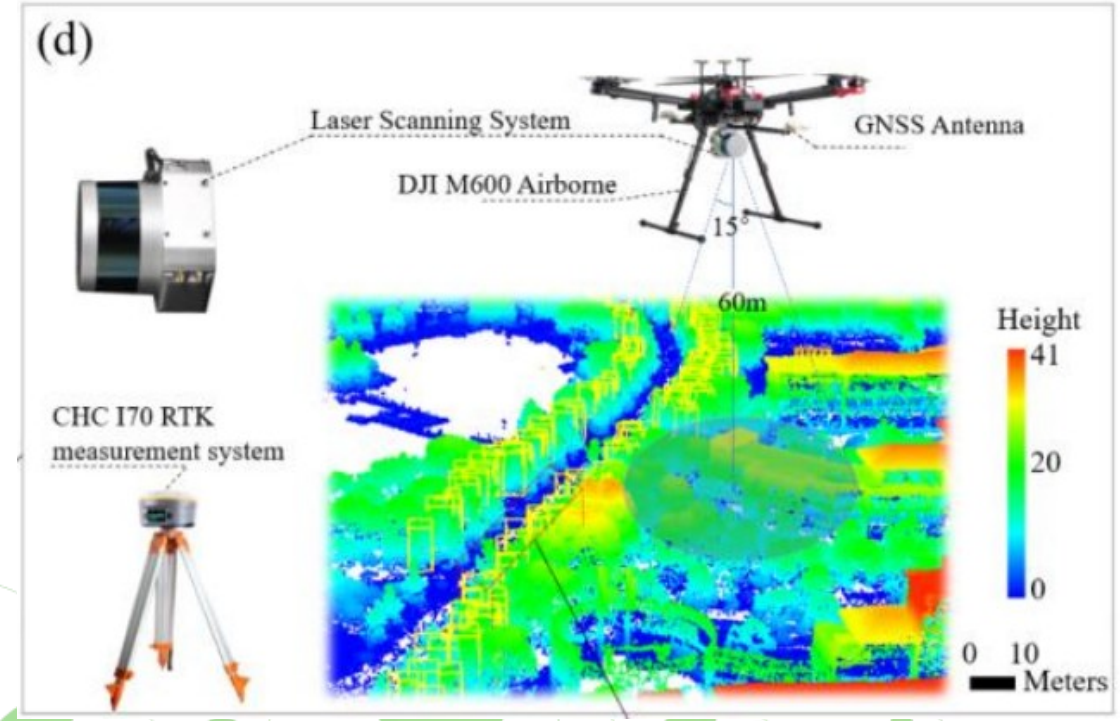
Other examples

Scanning the area with a drone.



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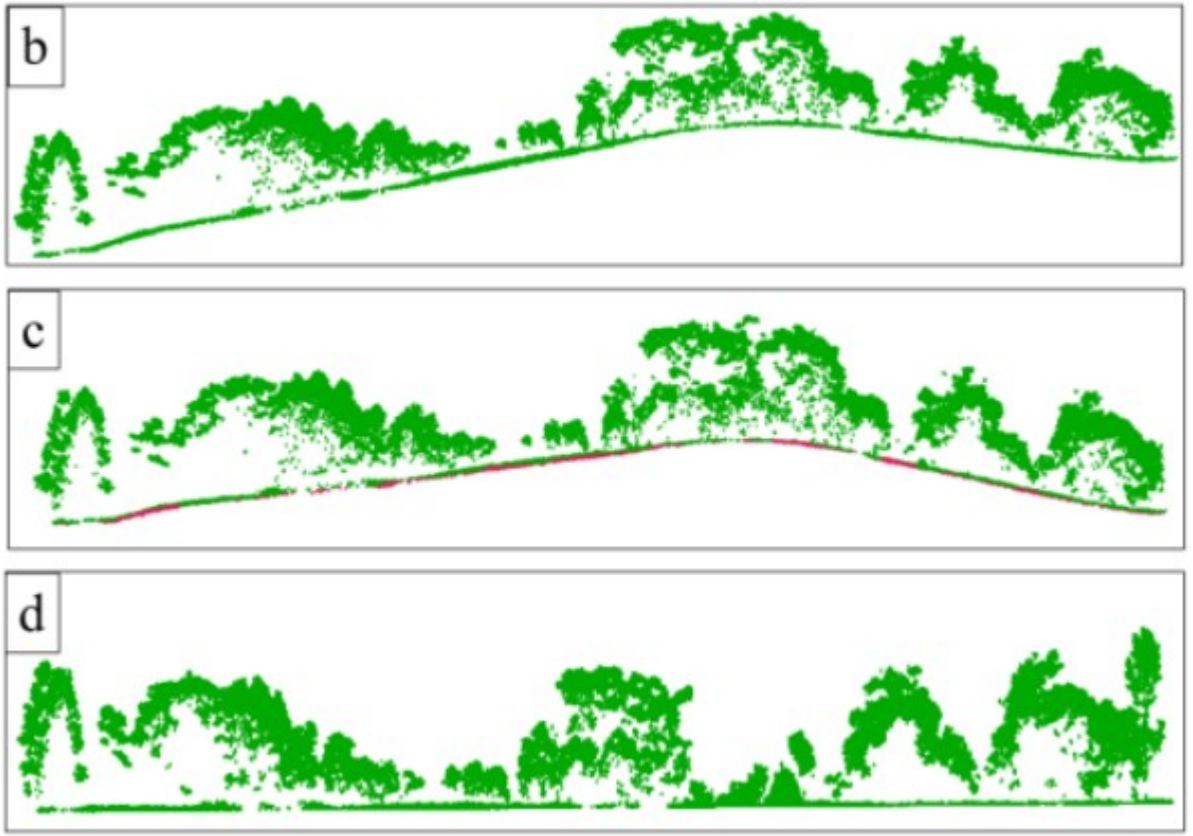
Other examples

Height normalization.



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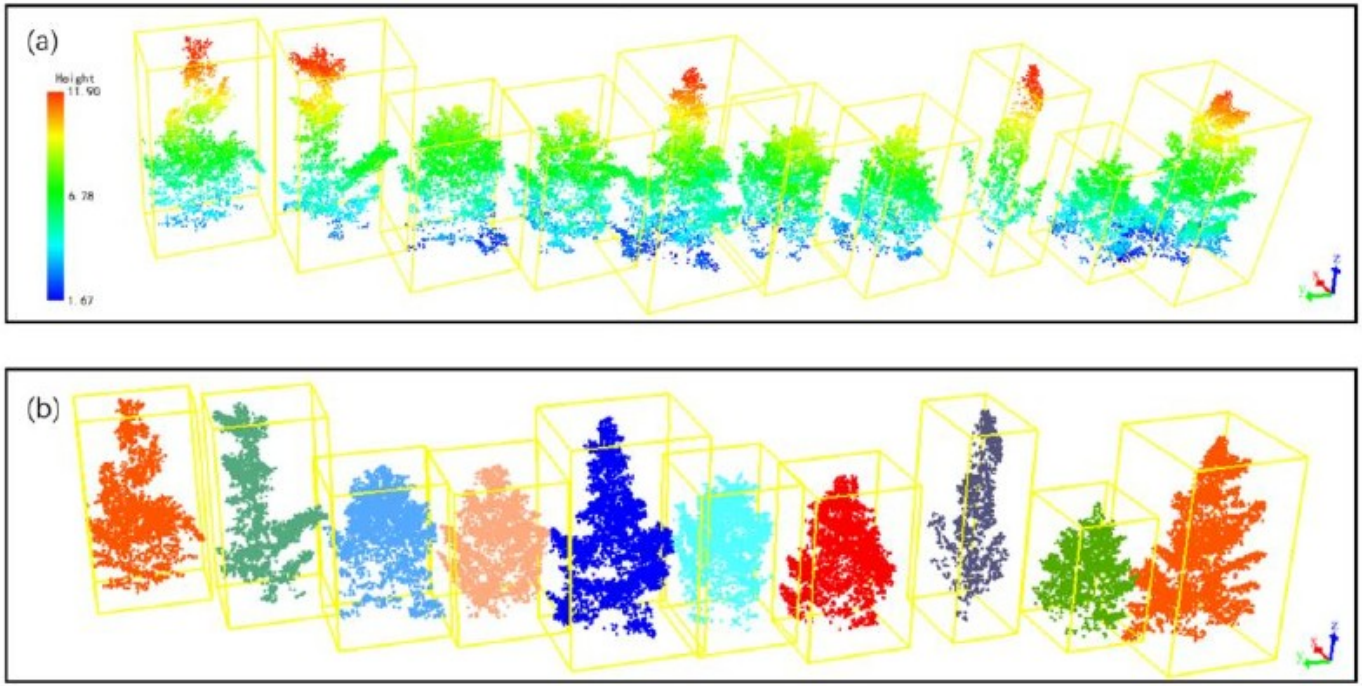
Other examples

Separating point clouds into individual trees and identifying.



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Thank you for your attention.

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This presentation will be available on:
WTD.ZabałaganioneMiejsce.pl

References

- **Król, P. M., & Podziewski, P. (2025). Drill focus-stacking (DrFS): computer vision toolset for tool wear measurement. Wood Material Science & Engineering, 1–8. https://doi.org/10.1080/17480272.2025.2486227**
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https://docs.opencv.org/4.x/d7/dff/tutorial_feature_homography.html,
https://allegro.pl/oferta/kamera-cyfrowa-agfa-cc2700-2-7k-48mp-stereo-pilot-12087786041
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