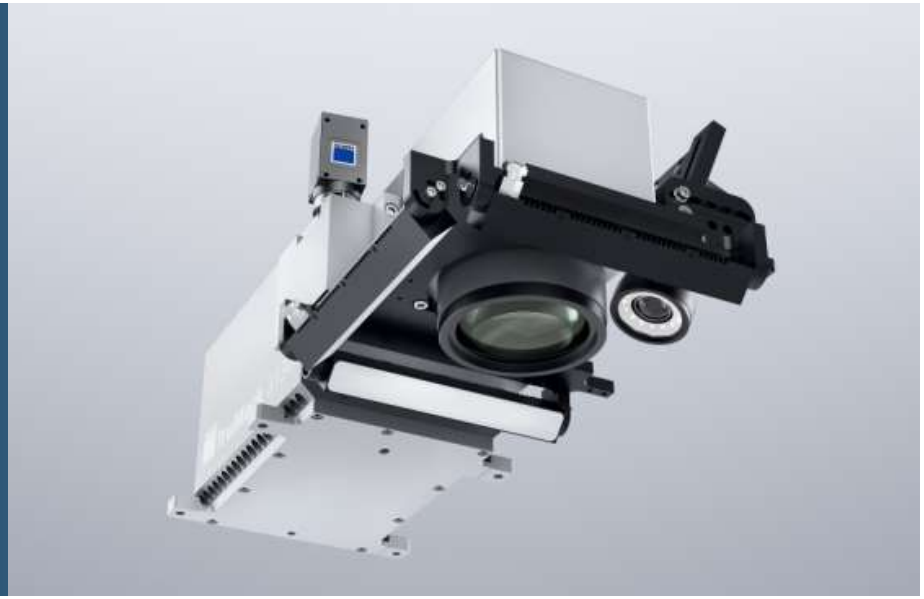


Presentation

# SWISS PHOTONICS
# Image Processing by TRUMPF

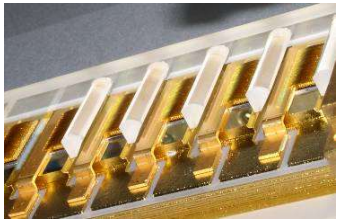
Reto Hidber, R&D Project Management

TRUMPF

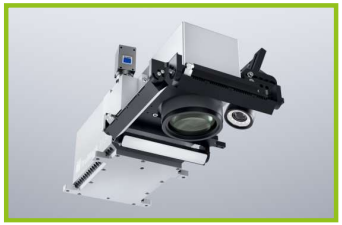
# TRUMPF – Products and Applications

## Sheet metal processing and laser processing



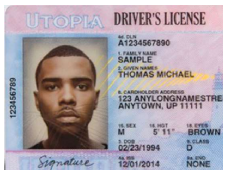


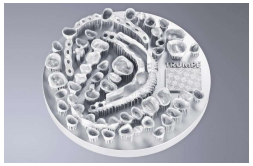


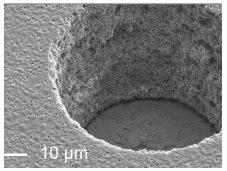


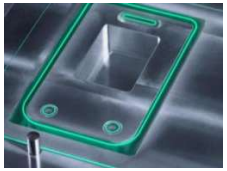
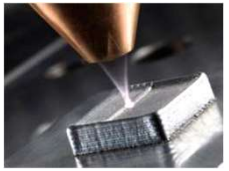
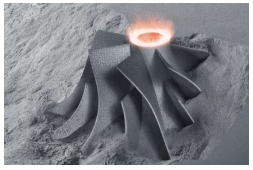












TRUMPF

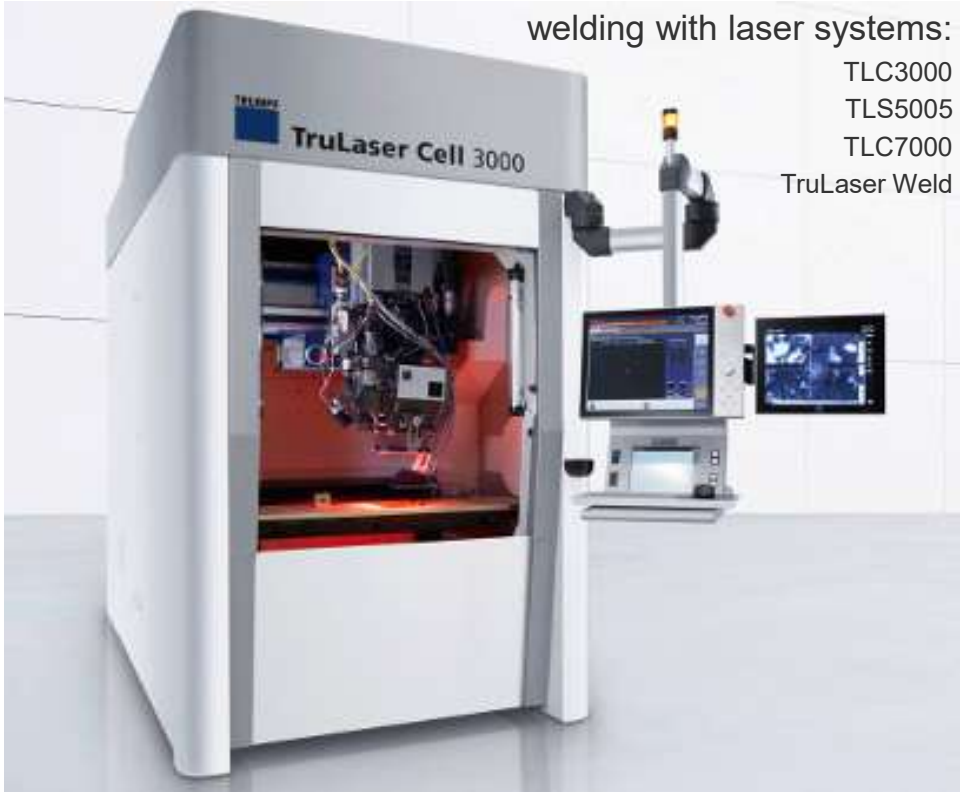
# VisionLine uses the same platform for different TRUMPF products

welding OEM package

marking OEM & systems

welding with laser systems:

TLC3000
TLS5005
TLC7000
TruLaser Weld



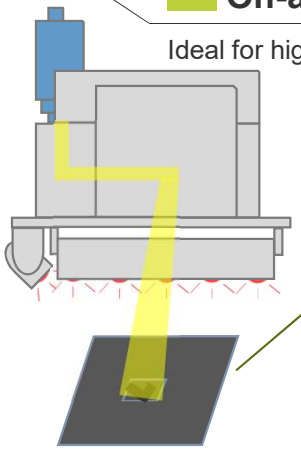
# VisionLine for marking

## Keeping an eye on everything with TRUMPF image processing

# Different camera configuration with focusing unit

## A On-axis with focusing unit

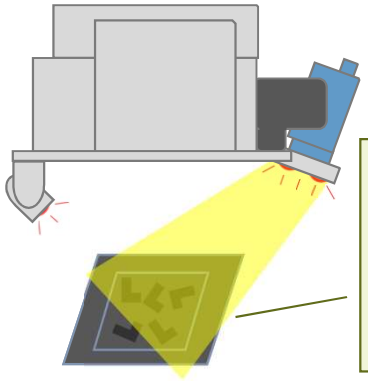
Ideal for high precision



The field of view of the camera depends on the lens size. The standard field of view is 7x10mm. Each point in the marker field can be approached quickly (10m/s) and precisely (<1µm).

## B Off-axis

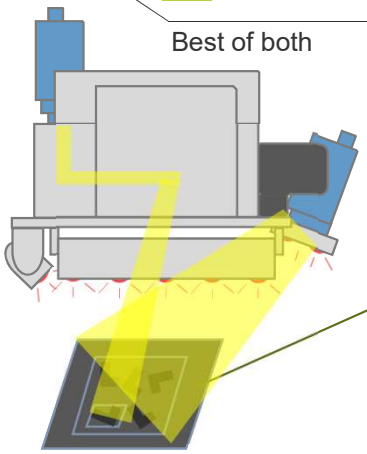
Ideal for large field of view



The off-axis camera overlooks the entire marking area. Drift effects from the laser and scanner are not compensated. The camera resolution is 60µm per pixel.

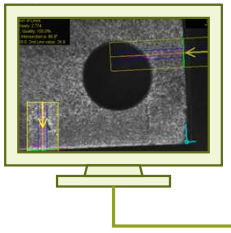
## C On-Axis with focusing unit & off-axis

Best of both

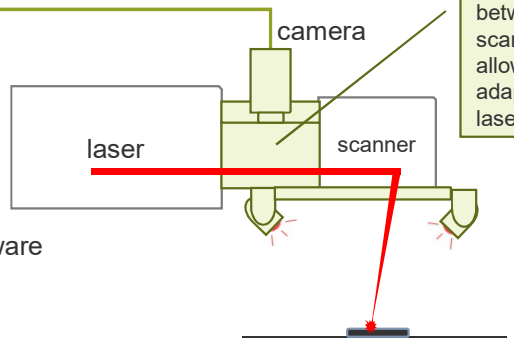


The off-axis camera is used for rough search with the subsequent fine search via the off-axis camera. The two cameras can be called sequentially.

## VisionLine Hardware

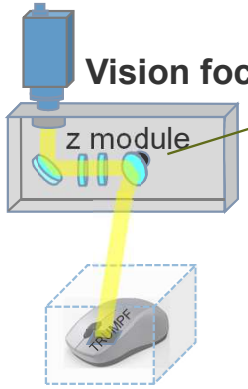


Panel PC with VisionLine software




The camera adapter is mounted between the laser source and the scanner. The modular principle allows you to use the same adapter for different types of lasers.

## Vision focusing unit




The camera adapter is equipped with a focusing unit. The VFU can focus the on-axis camera on a volume (x,y,z) equal to the volume reachable by the laser focus. The laser and the camera has its own focusing unit so the focus can be adapted independent.

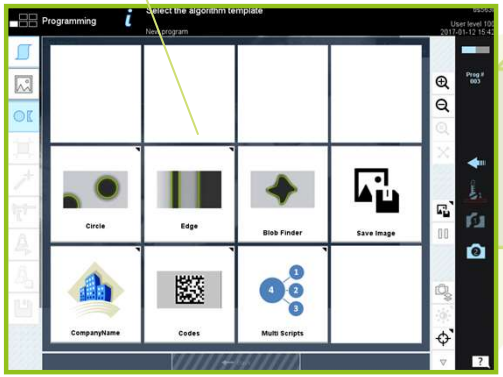


TRUMPF

# VisionLine’s standard pattern library

The modular principle allows a wide variety of use cases to be covered.

The VisionLine software defines unique jobs. Each job defines the scanner position (x,y,z), the camera settings (gain, exposure) and the image processing function for each camera.




**Detect Pro** — model finder
contains Detect and Adjust
Coming soon

**Trace Pro** — code reading & customized grading
contains Trace and Adjust
2D code grade
OCR

**Detect** — feature detection
contains Adjust
line crossing
segment line crossing
blob circle
line
segment crossing
blob
circle
long line crossing
mean of 2 points
circle from N points
Find 3 lines
segment

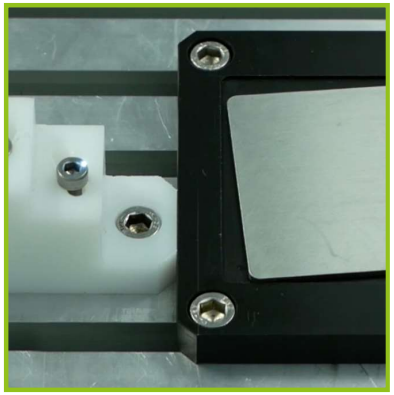
**Trace** — code reading
contains Adjust
2D code read
1D code grade
1D code read

**Adjust** — automatic focus search for laser and camera
contains complete VisionLine Hardware

# Position correction use case

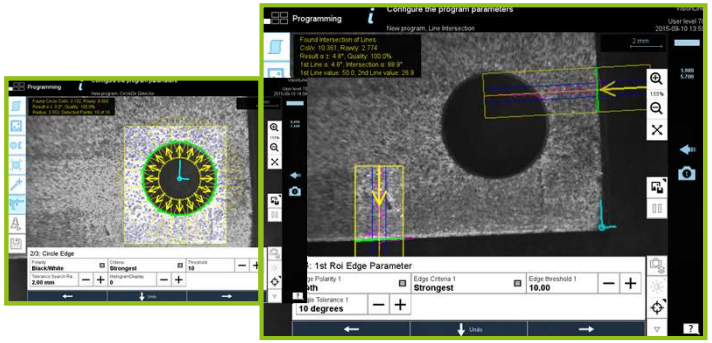
Detect

## A The components to be labelled are roughly fixed



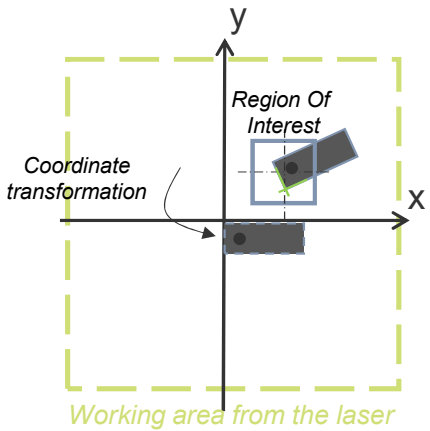
The complicated fixation of the objects is no longer necessary. Fixations can be made faster, more flexibly and more cost-effectively.

## B Position recognition e.g. over edges or specific features such as holes



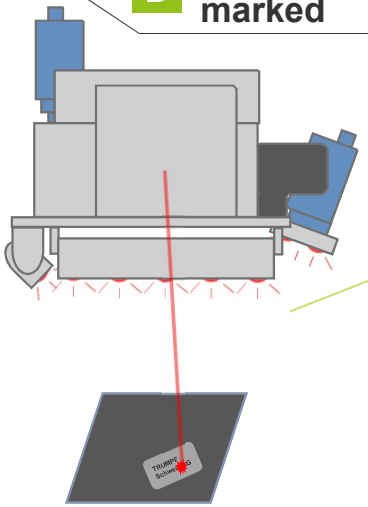

The image processing software compensates the inaccuracy of the fixations.

## C The content to be marked is moved to the detected position




With the help of the coordinate transformation…

## D Finally the material is marked



…the marking content is lasered in the correct place.



TRUMPF

# Code reading and grading use case

Trace | Trace Pro

## A After the laser marking process

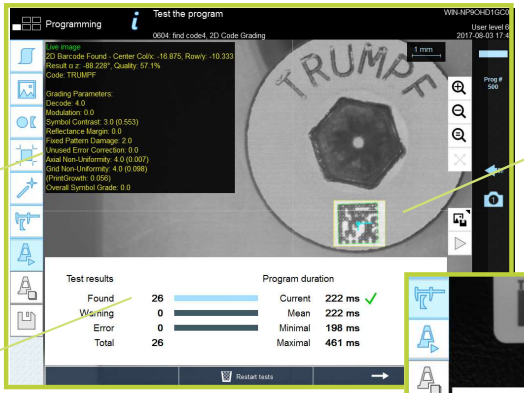

Most products in the automotive and medical industries contain a machine readable code

## C Postprocessing

The code content is evaluated, for example via a target-is comparison or written into a database

**Code marked = Code read**

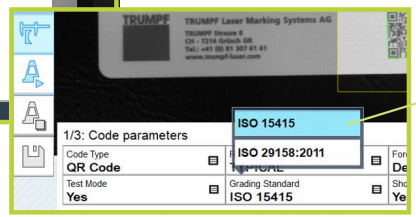
## B Read or verify code




Grading results

code within region of interest (ROI)

processing statistics for reading and grading



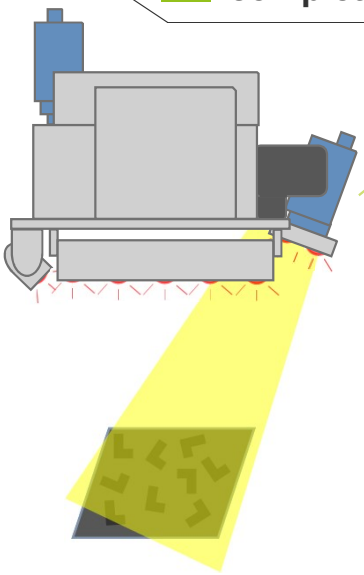

Customized Grading by ISO 1545 or ISO 29158:2011
Full norm grading depends on the lighting constellation.

# Modelfinder use case

*Detect Pro*

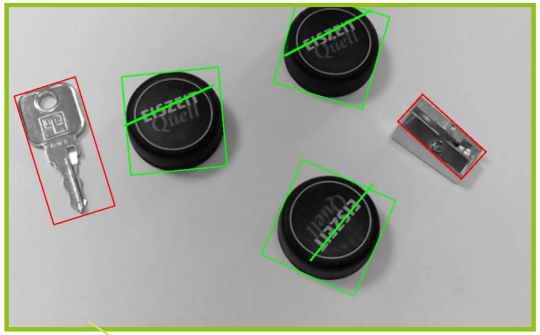
Coming soon

## A Off-Axis camera observes complete marking field



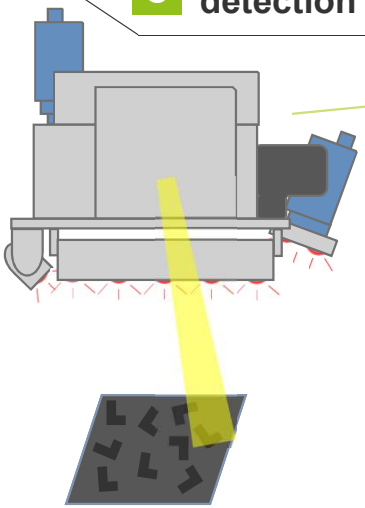
The objects to be recognized are learned.

## B Locate each part with model finder functionality



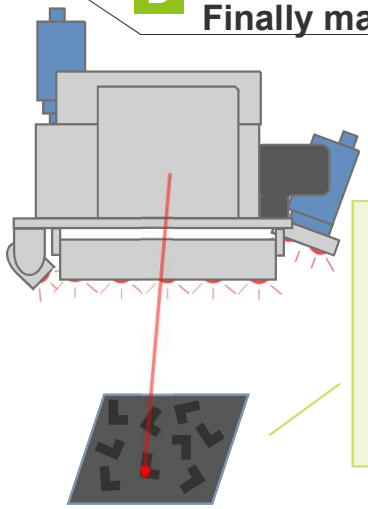
The algorithm recognizes the learned object and marks it if it matches the specification.

## C Accurate position detection of each part



For even more accurate detection, the object is measured in detail using the on-axis camera.

## D Finally marking material



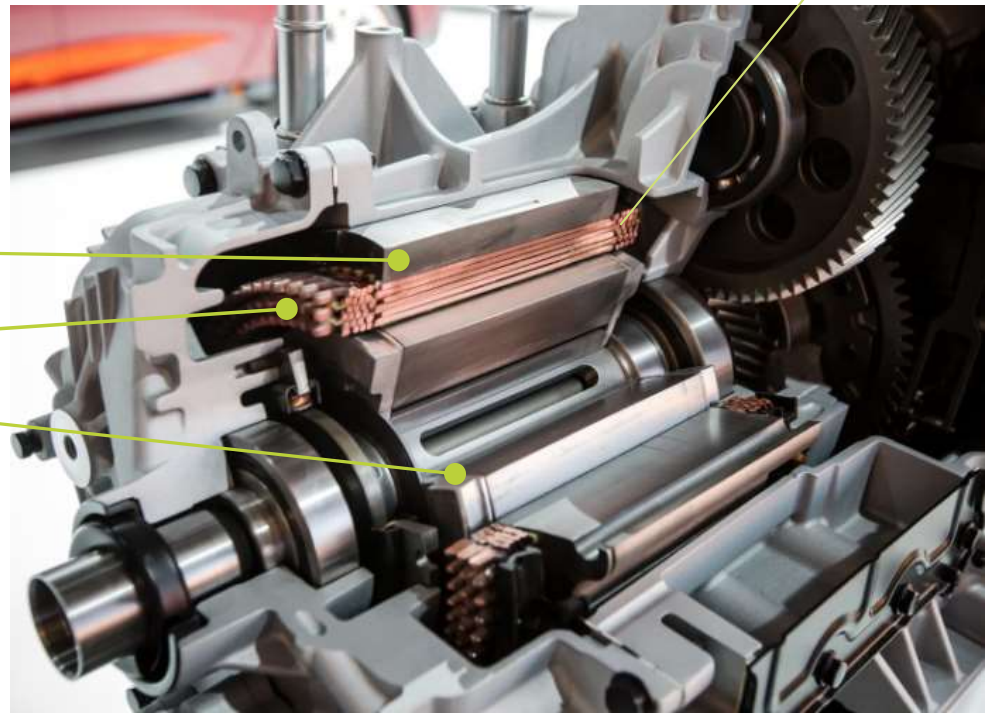
The parts are marked one after the other in the right place. The productivity is greatly increased. Further integration with automatic feed and removal of the parts is possible.

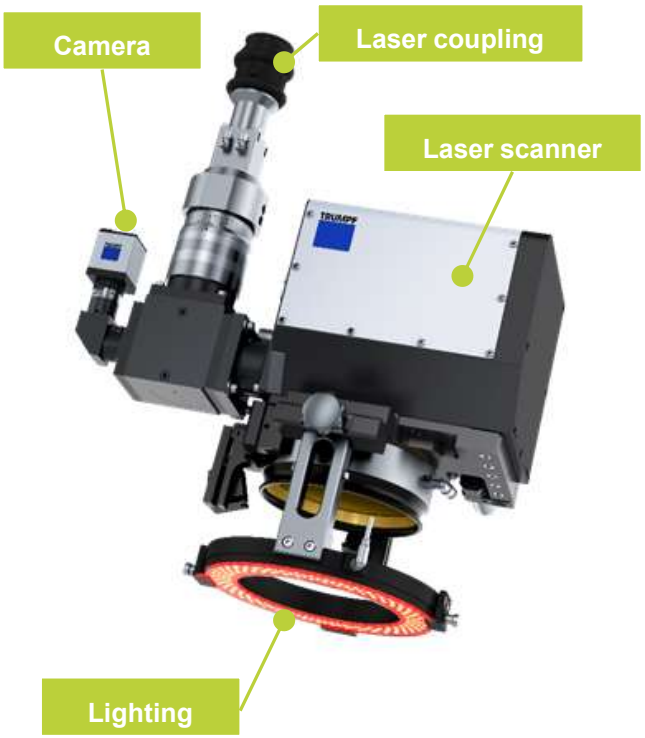
TRUMPF

# Hairpin welding in electromobility

## New application for laser processes.

The coil in the electric motor is manufactured using the Hairpin technology

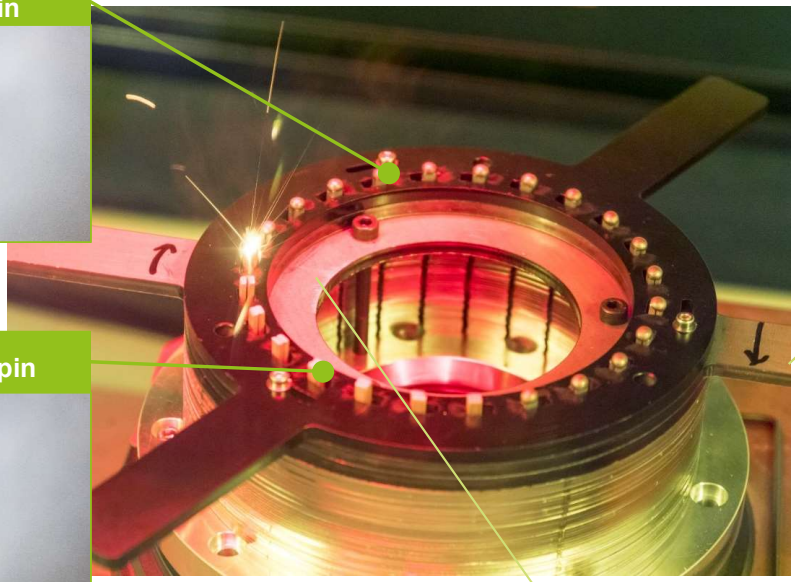


# Hairpin welding in electromobility

welded hairpin

unwelded hairpin



The hairpin ends of an electric motor stator are welded by the laser.

The VisionLine system recognizes the midpoint of every hairpin pair. The image processing also recognizes malposition of the pins.

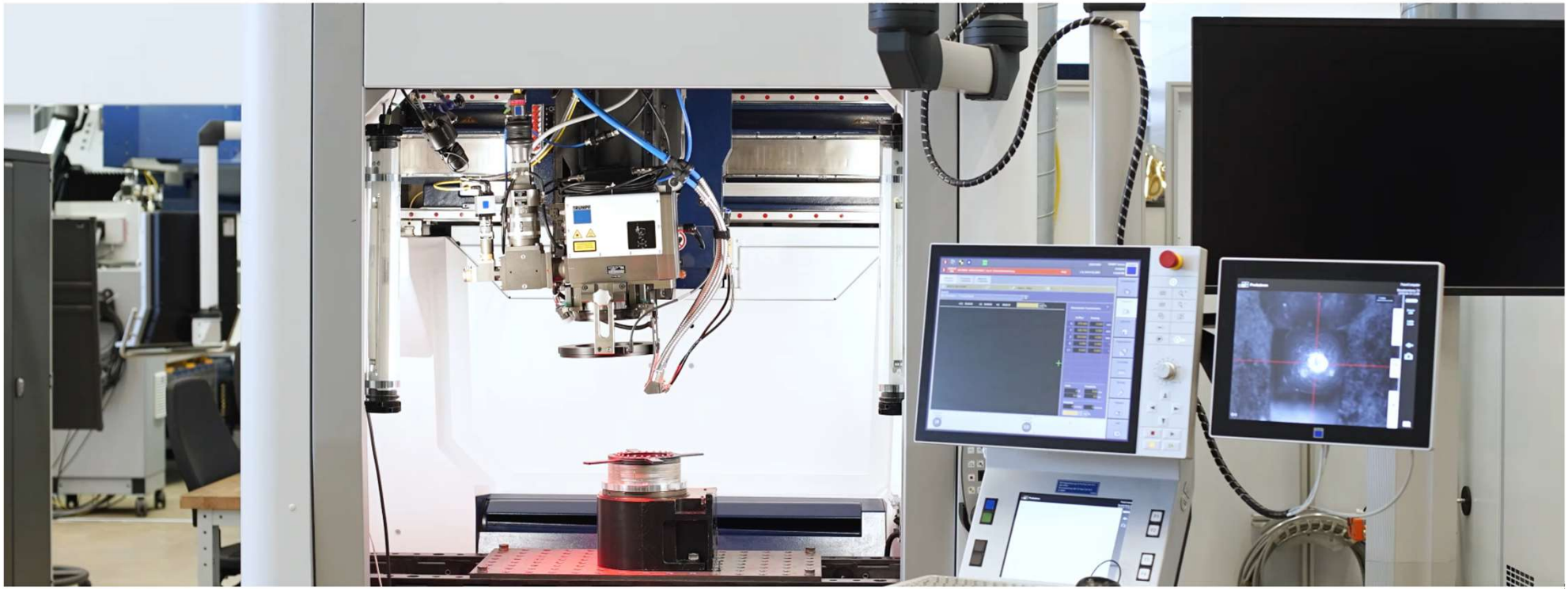

The laser welds the hairpins together. The laser beam is directed to each center via the beam deflection unit (scanner).



TRUMPF

# Reliable hairpin welding with image processing VisionLine

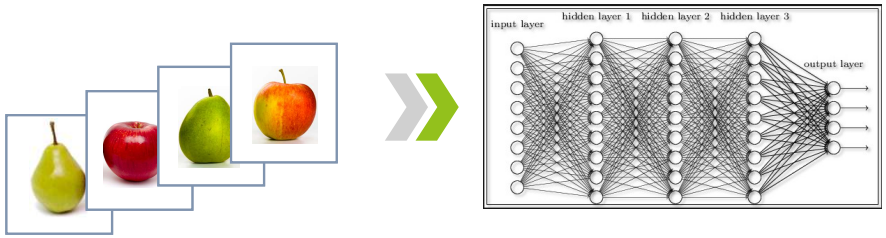
## Everything in view during welding



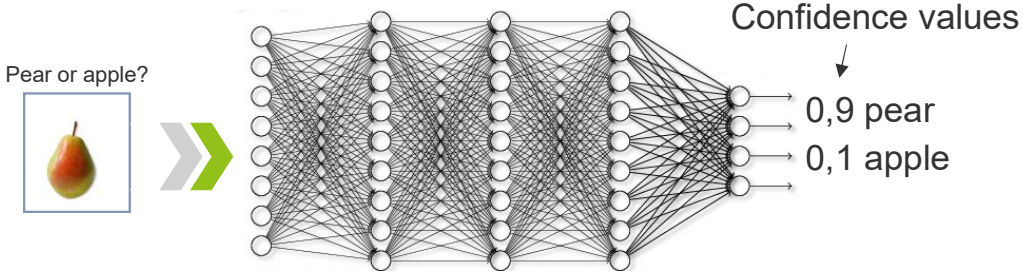
# Outlook: Use of deep learning in quality assurance

## Good / bad rating with hotspot display

**A** **As part of a training phase, the deep learning algorithms are taught.**

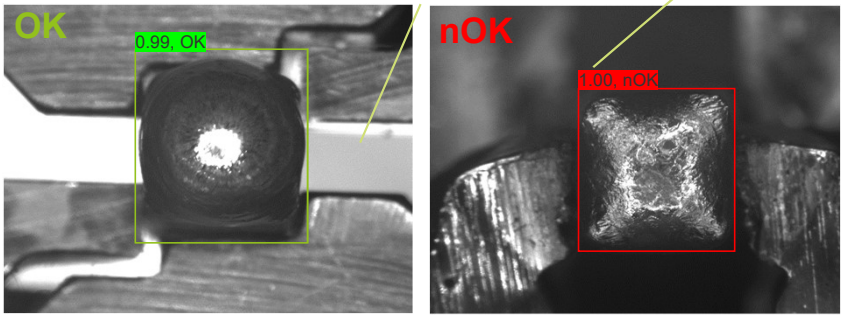



**B** **With the training set the new pictures are qualified.**



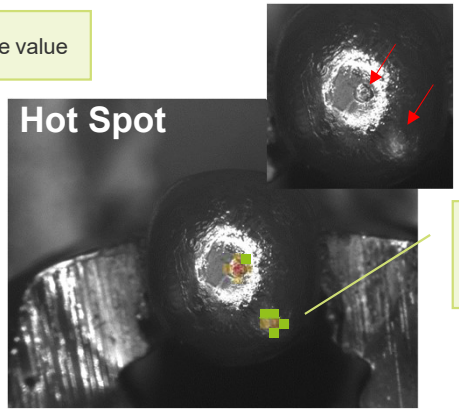

Good welds are different from bad welds. A failure of a welding site leads to the failure of the electric motor!

Confidence value










Smallest activities in the welding are recognized.

Bildquellen: mit freundlicher Unterstützung der Grob-Werke GmbH & Co. KG



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