



# Coin edge inspection - How to integrate in automatic, high throughput processes

Technical Forum  
Berlin 2015





- Purpose
- Different methods of edge inspection
- Examples
- Summary and outlook

## Automatic coin inspection still has a weak spot: Edge inspection

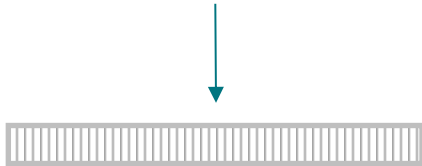
- Front and reverse side → proven methods for inspection already available.
- Correct edge lettering & serration → important, but still no reliable & fast method to inspect.
- Integration of coin edge inspection into established fully automatic process is needed.



## New approach

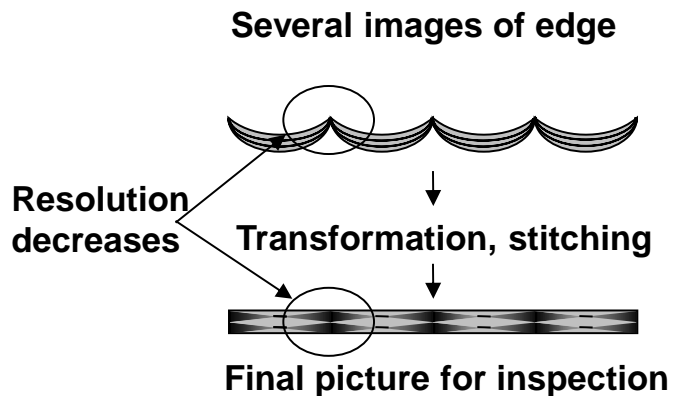
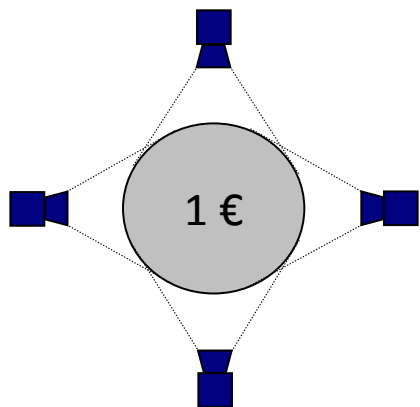
The best way to take an image of a cylindrical surface is:

- to take **one** rotationally symmetrical image at the optical = symmetry axis
- **not** to put several images from the side view together



## Example

e.g. 4 cameras

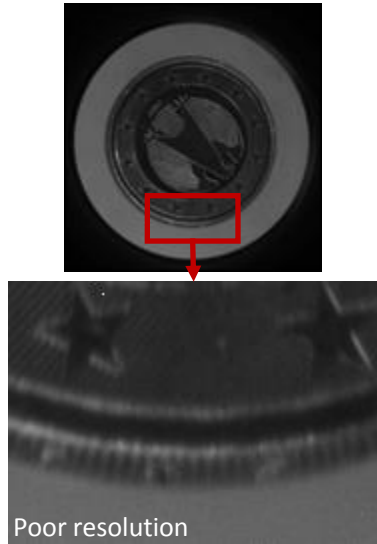


- Distorsion etc.
- Single pictures have to be stitched for best results

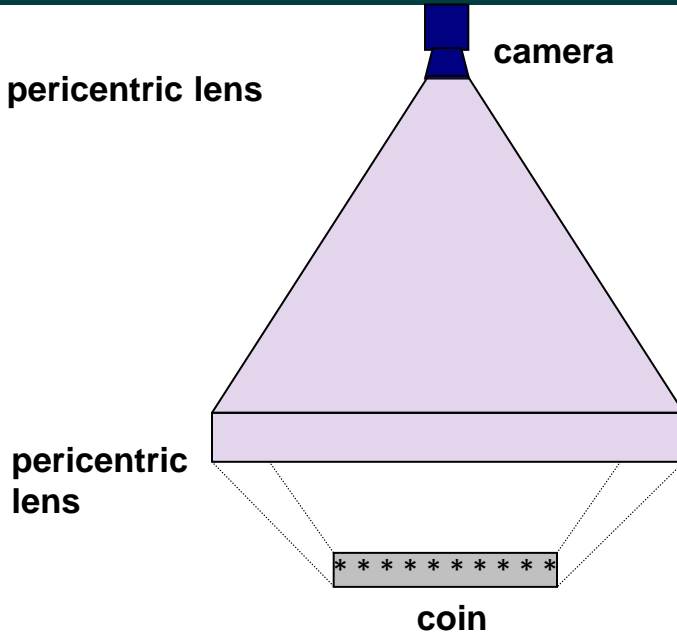
# Edge inspection: pericentric lens

Usual practice today

## Example



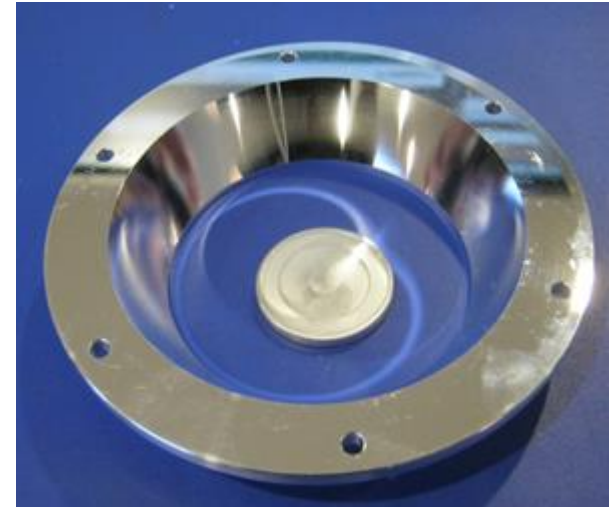
e.g. pericentric lens



→ Poor resolution  
→ Expensive lens

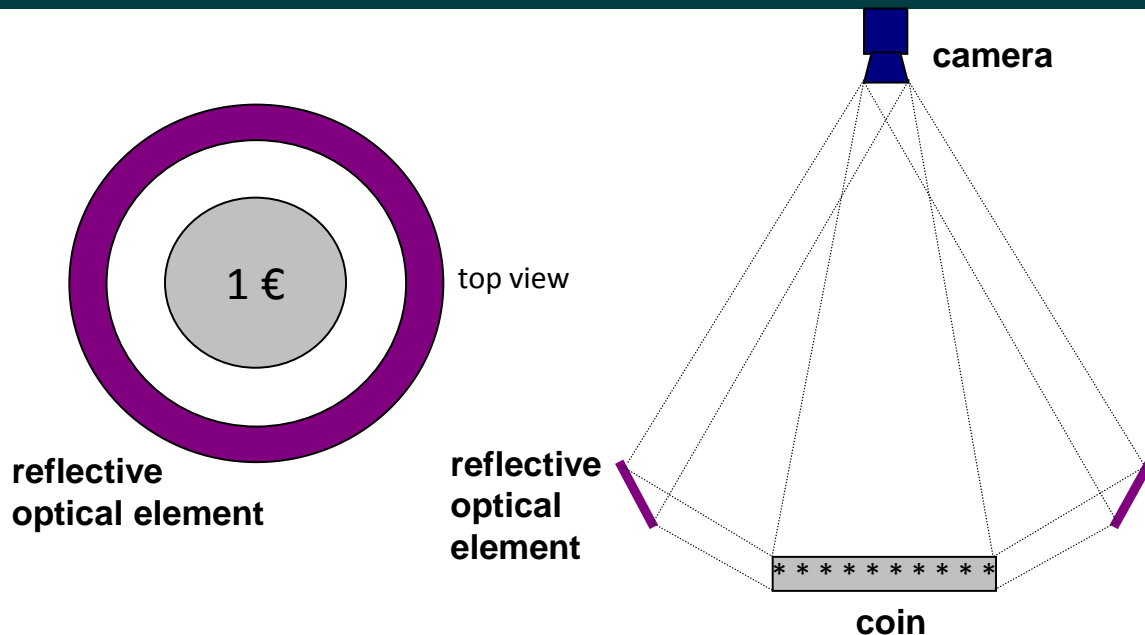
## New approach - details:

- Aspherical surface with coating has been developed.
- Only **one** picture needed for **one** surface **and** edge inspection.
- Optical sensor for triggering → high precision.
- Short exposure time → very clear image because of high photon flux and small aperture.





## New approach - details:



- **No** Distortion etc.
- Single pictures have **not** to be stitched
- **One** picture for **one** surface **and** edge-inspection

## Specification

- High throughput: e.g.  $v = 2 \text{ m/s}$
- Resolution  $100 \mu\text{m}$ 
  - Exposure time  $50 \mu\text{s}$  !
- High photon flux needed
  - Flashed high power LED
  - Aspherical surface

## Aspherical surface

Étendue (geometrical flux)  $G = A \cdot \pi \cdot (NA)^2$

A: Field area surface

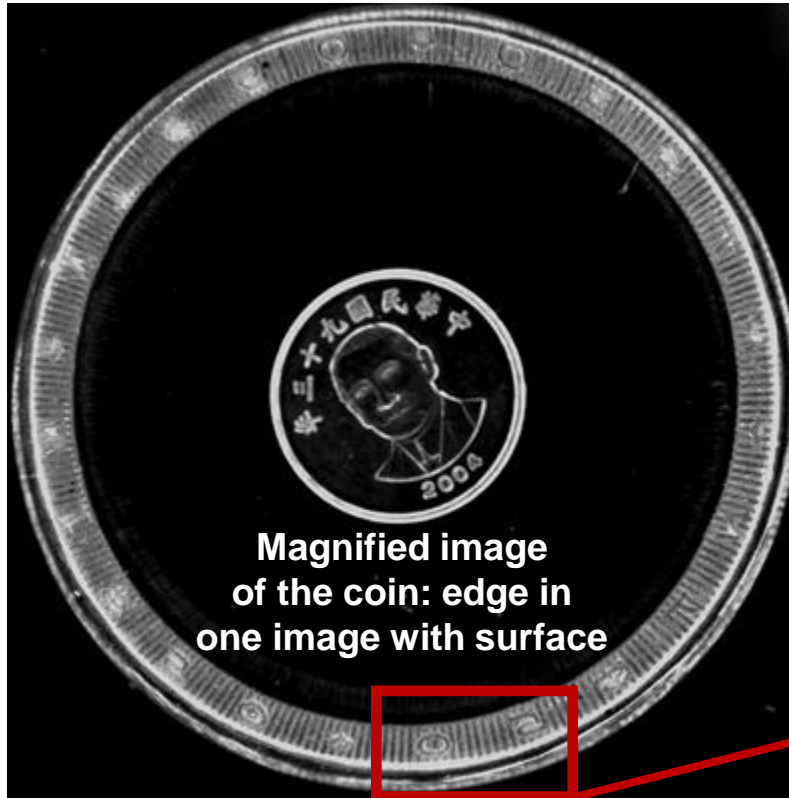
NA: Numerical Aperture of next surface

Higher Étendue: e.g.  $\rightarrow$  higher NA

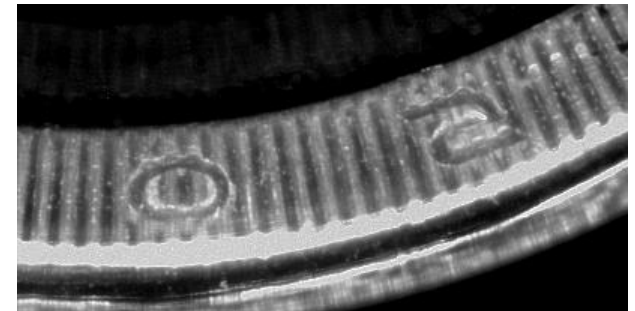
Normal angle of acceptance from one point at edge of coin:  $< 3^\circ$

Angle of acceptance of aspherical surface:  $\approx 27^\circ$

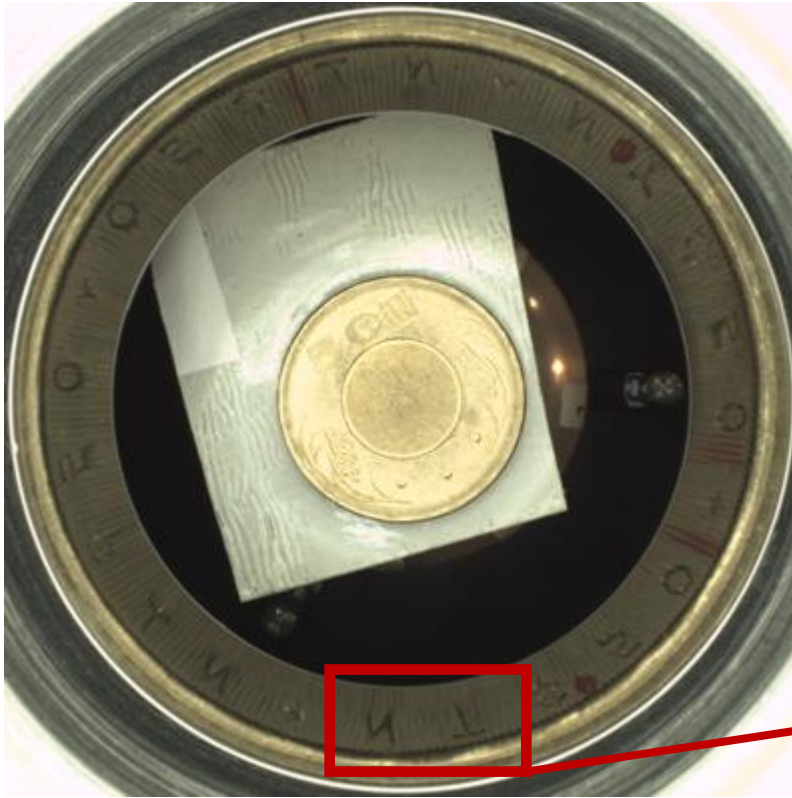
$\rightarrow \approx 9$  x more photons from one point



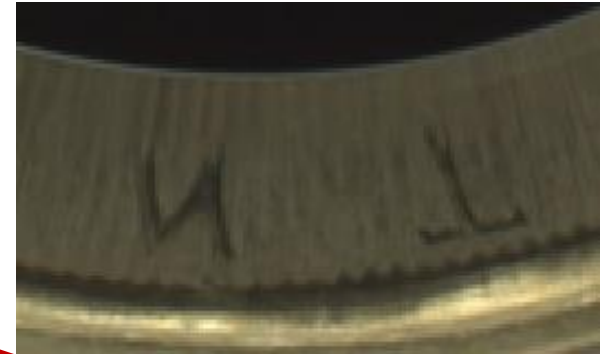
Taiwan 50 Yuan



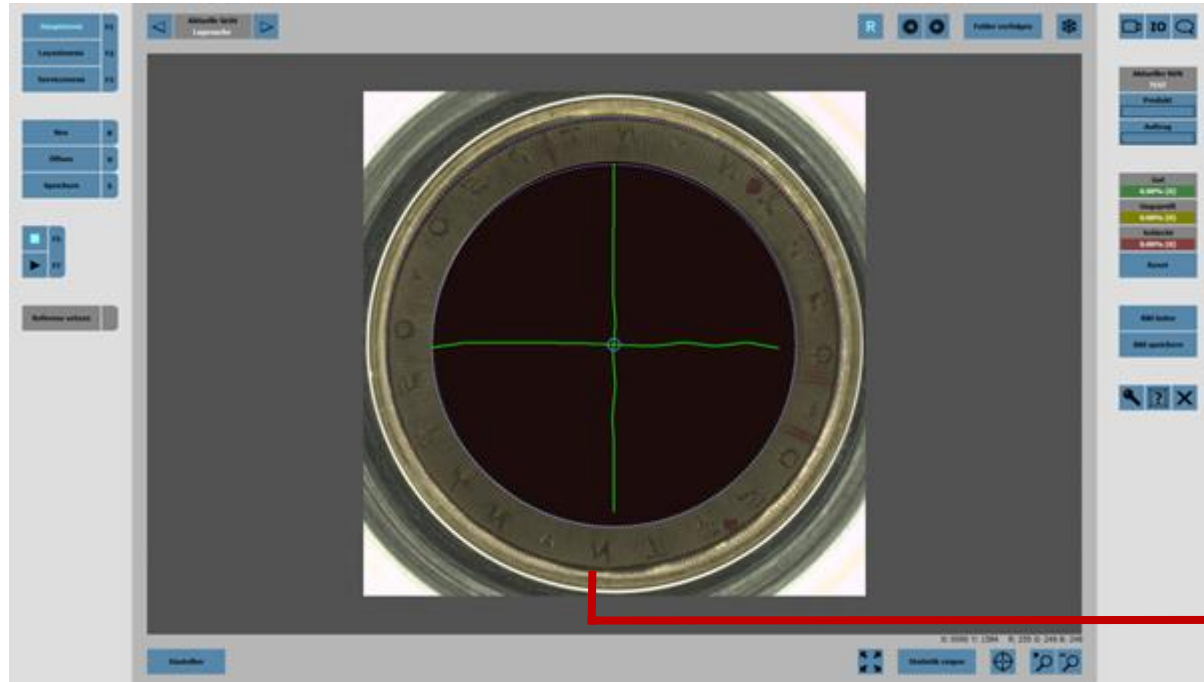
# Edge inspection: examples



Taiwan 50 Yuan



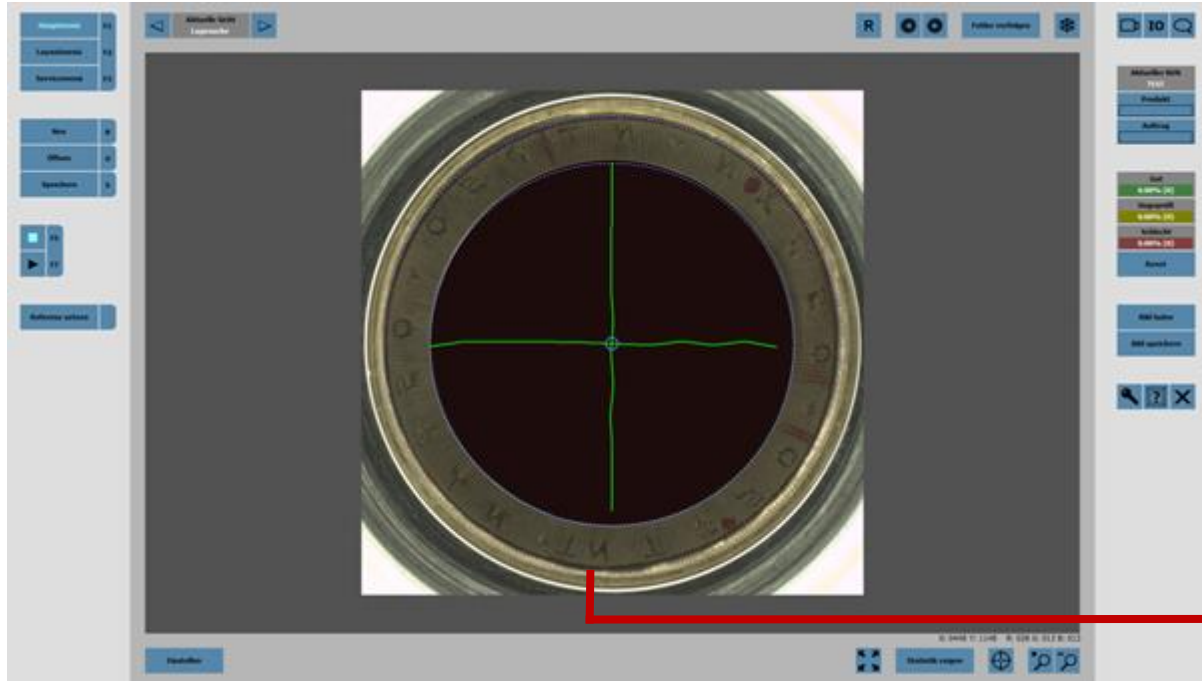
# Edge inspection: examples



OK

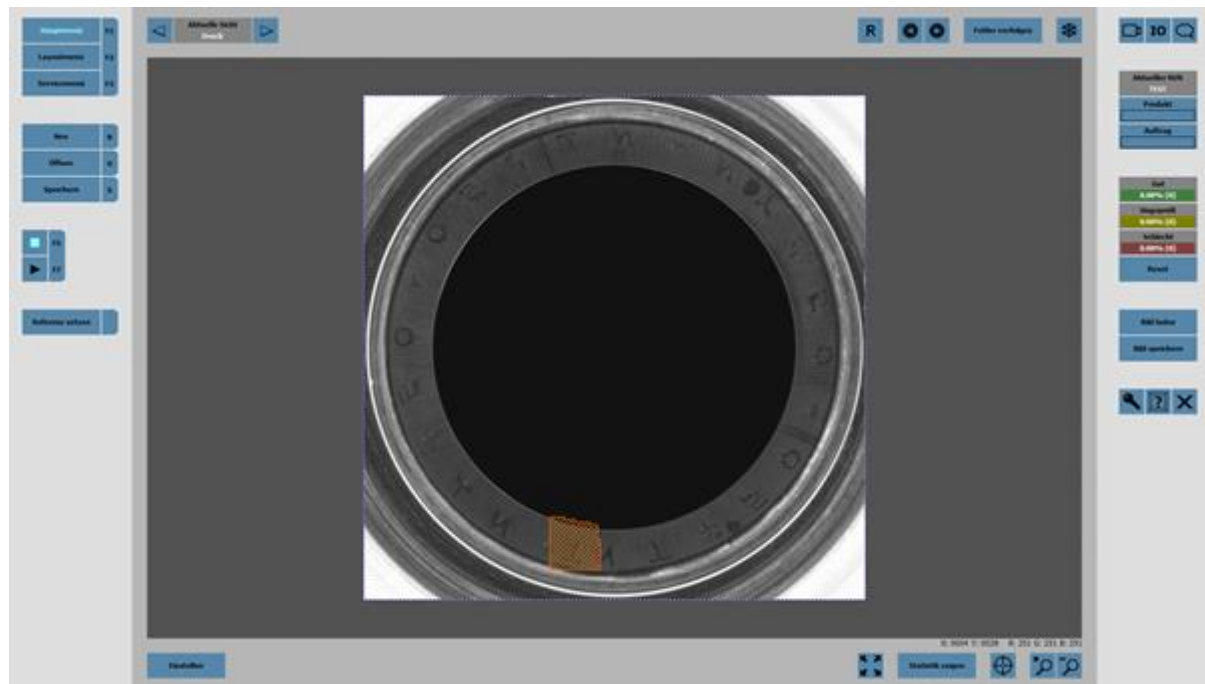


# Edge inspection: examples



Not OK,  
wrong letter





**Not OK, wrong letter**

→ software evaluates  
within milliseconds

→ coin will be rejected



## Final picture for edge inspection



## Final picture (analyzed) for edge inspection: Other algorithm looks for defects on surface





COIN INSPECT



- High resolution (magnification), no distortion in image
- Just **one** image for **one** surface **and** edge
- Can be integrated into established fully automatic process

Thank you very much for your attention !

Questions ?

Please also visit us at booth B26.

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