

# INLINE COMPUTATIONAL IMAGING

AIT Inline Computational Imaging (ICI) is a new type of image acquisition system for simultaneous 2D and 3D inspection even for challenging inspection tasks.

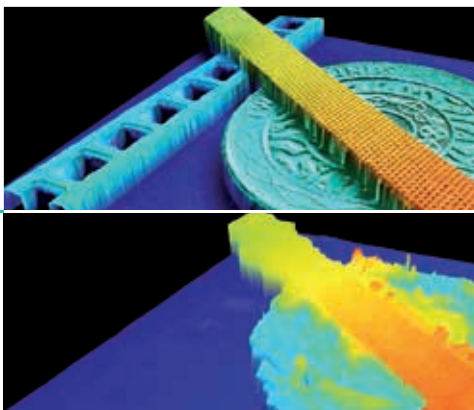
## OPPORTUNITIES

- Enhanced 2D imaging, e.g. gloss / shadow reduction, all-in-focus, high-dynamic range, etc.
- Simultaneous 2D and 3D inspection
- 3D measurements down to  $\mu\text{m}$  range
- Advanced inline inspection for 2D and 3D features even for materials with challenging surface properties
- Material classification, e.g. metal vs. plastic
- Inspection of optically variable devices and holograms
- Detection of defects and fine surfaces structures

## ADVANTAGES

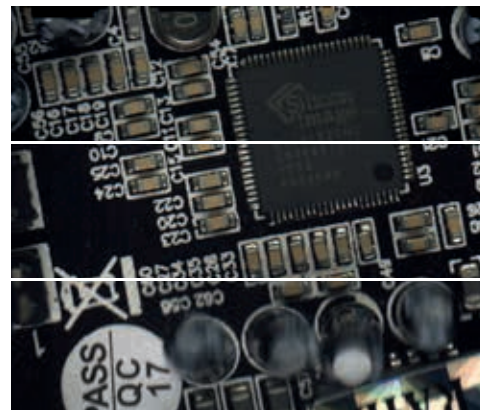
- Reliable, fast and accurate
- Simple and compact, using only one camera
- Easy to integrate
- Works for objects with different surfaces (matt / glossy, structured / unstructured)
- Inspection in motion (no stop-and-go required)
- Dynamic adaptable to changing requirements in terms of speed, accuracy and surface quality
- Patented technology

AIT ICI  
3D reconstruction



state-of-the-art  
3D stereo  
reconstruction at  
the same baseline

AIT ICI  
gloss suppression



all-in-focus image

blurred image  
using state-of-the-  
art methods

## JOINT LIGHT FIELD & PHOTOMETRIC STEREO IMAGING

AIT Inline Computational Imaging (ICI) combines the advantages of light field and photometric stereo technology into one compact solution. ICI is a new type of image acquisition system combined with smart algorithms to solve even challenging inspection tasks.

### LIGHT FIELD

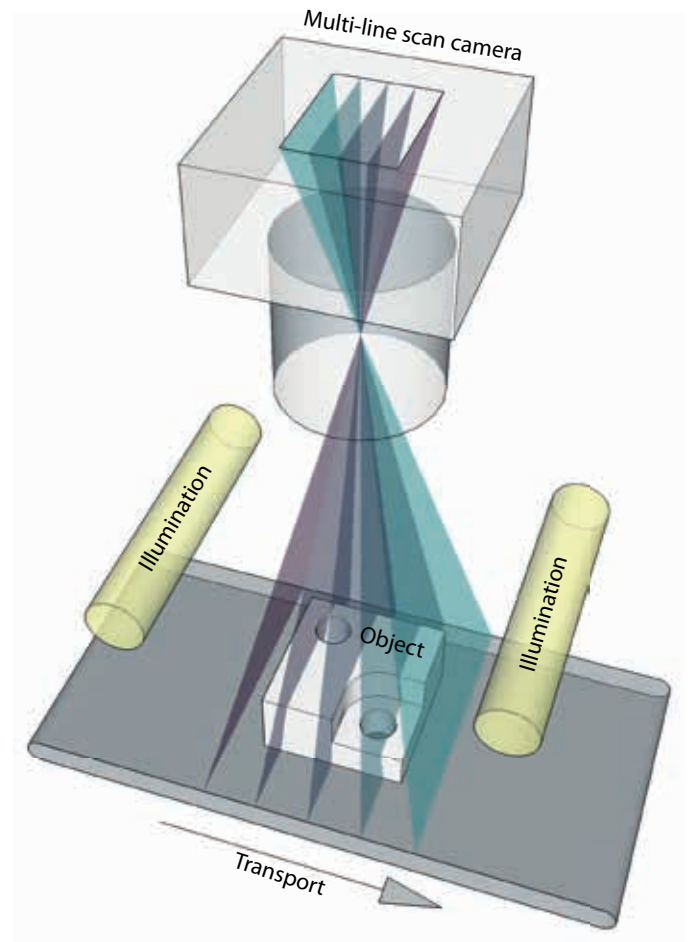
A light field consists of multiple views of an object obtained from different viewing angles. It can be understood as an extension of conventional stereo systems but uses more than two object views. Combined with advanced algorithms it allows for more accurate and robust calculation of depth information compared to a standard stereo approach.

### PHOTOMETRIC STEREO

Photometric stereo technology makes use of different illumination angles. The amount of light reflected by a surface is dependent on its orientation in relation to the light source and the camera. Measuring the amount of light reflected into a camera, the space of possible surface orientations is limited. Given enough light sources from different angles, the surface orientation can be calculated.

### AIT ICI COMBINES LIGHT FIELD & PHOTOMETRIC STEREO

By using one multi-line scan camera, constant illumination and a moving sample part the AIT ICI technology is a smart combination of light field and photometric stereo imaging. Each line observes the object under a slightly different viewing and illumination angle than the other lines. Algorithms designed specifically to work with this recording setup provide enhanced 2D images together with detailed 3D reconstruction.

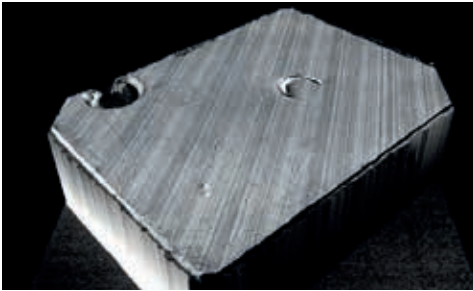


## HIGHLIGHTS

- MULTIPLE VIEWING & ILLUMINATION ANGLES
- SINGLE SOLUTION FOR ENHANCED 2D IMAGES & 3D INFORMATION
- FULL OPTICAL RESOLUTION
- FLEXIBLE IN SPEED AND ACCURACY
- ENHANCED IMAGE QUALITY FOR MORE ACCURATE DEFECT DETECTION
- MATERIAL CLASSIFICATION & 3D INSPECTION

## NEW OPPORTUNITIES FOR INDUSTRIAL INLINE INSPECTION

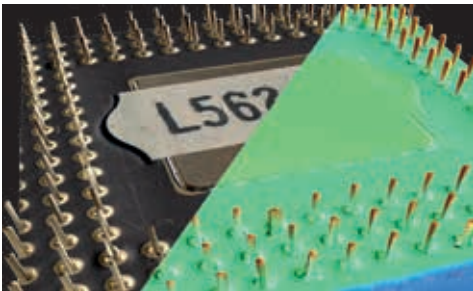
Inline Computational Imaging offers numerous new possibilities for industrial inline quality inspection. The technology was specifically developed for high-performance industrial inline inspection and thus it is suitable for a wide range of applications. To meet the industrial requirements, it works largely independent from the objects surface properties which means one can inspect glossy as well as matt, structured, unstructured and even dark objects with a single setup. Defects down to the range of a few  $\mu\text{m}$  can be detected with high accuracy and reliability.



### METAL PARTS

Simultaneous 3D measurement and surface quality inspection for metallic parts can be solved using ICI technology. The advantage of using several viewing angles makes the detection of cracks, pores and other surface defects much more robust than using standard machine vision solutions. ICI is a suitable solution for metal surface inspection e.g. for

- Crack detection, distinguish between machining marks and scratches, cracks, etc.



### ELECTRONIC PARTS & PCB INSPECTION

Inspection of electronic parts and PCBs must cope with challenges like e.g. glossy solder spots and dark assembly parts with dark labelling. ICI solves these challenges and can be used for

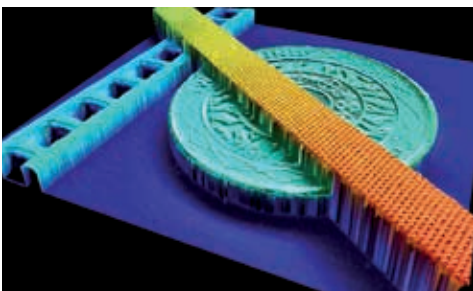
- Solder inspection, detection of bad solder spots
- Assembly control including 3D inspection for pin heights
- Inspection of glossy and dark matt materials at the same time
- Wafer inspection (e.g. cracks)



### SECURITY PRINT INSPECTION

Besides traditional color imprint inspection ICI can go further. It can perform

- Inline hologram inspection, not only for presence but also to check for the correct color shifting effects
- Quality inspection of intaglio print and tactile elements (3D depth)
- Inspection of embossings, e.g. braille writing, seals, etc.
- Inspection of decor elements like high gloss printings and lacquered areas

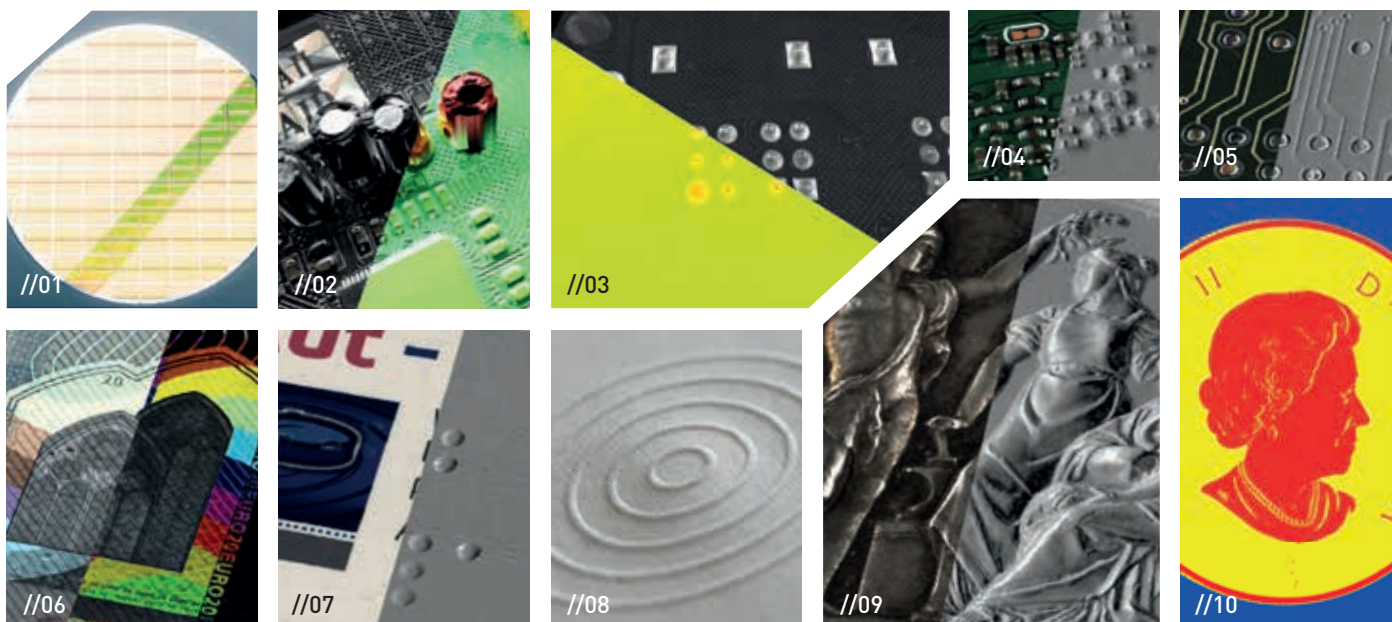


### INSPECTION OF CHALLENGING MATERIALS

ICI works largely independent from the objects reflectance properties. It provides high quality 2D images together with precise 3D reconstruction also for challenging objects, like highly glossy, unstructured and even dark materials.

- 2D and 3D inspection with one system
- Flexible parametrization for inspection speed and accuracy
- Works well with challenging reflectance properties





## TECHNICAL DATA

Optical resolution	4 to 100 $\mu\text{m}$
Multi-line rate	max. 120kHz
Field of view perpendicular to transport	9 to 230 mm
Depth resolution	same as lateral resolution
Nr of viewing angles	min. 5   typ. 11

## SETUP

Nr of cameras / illuminations	1 / 2
Standard non-telecentric lens	yes
Strobing	no

## FEATURES

	Basic	Advanced
Object complexity	flat	3D
High dynamic range images	yes	yes
All-in-focus image	no	yes
3D point cloud	no	yes
Surface normals	yes	yes
2D gloss-, shadow-reduction image	yes	yes
Compensation of motion artefacts	simple	advanced

## ELECTRONIC

//01 Wafer inspection  
 //02 PCB assembly 2D & 3D  
 //03 Solder inspection  
 //04 PCB assembly  
 //05 Bare PCB

## PRINT

//06 Hologram inspection  
 //07 Braille embossing & print inspection  
 //08 Embossing

## METAL

//09 Coin 3D and texture  
 //10 Material classification  
 blue = matt | red = semi-glossy | yellow = glossy

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