

INLINE COMPUTATIONAL IMAGING

AIT Inline Computational Imaging (ICI) is a novel single sensor technology for simultaneous 2D and 3D inline inspection for challenging inspection tasks.

OPPORTUNITIES

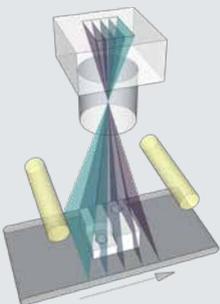
- Combined 2D and 3D inspection
- Enhanced 2D imaging, e.g. gloss / shadow reduction, all-in-focus, high-dynamic range, etc.
- 3D measurements down to μm range
- Advanced inline inspection for 2D and 3D features for materials with challenging surface properties
- Inspection of optically variable devices and holograms
- Detection of defects and fine surfaces structures

ADVANTAGES

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

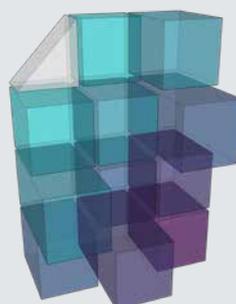
ICI SENSOR SYSTEM

Single Sensor Technology for Simultaneous Light Field and Photometric Stereo Capture



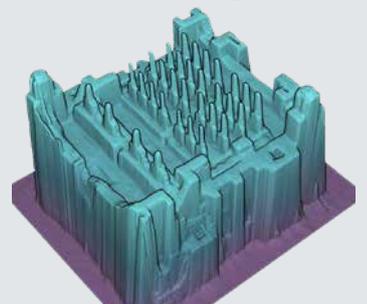
ICI SOFTWARE

Generic Computational Imaging Library for 2D/3D Tasks



ICI SOLUTION (2D & 3D)

3D Point Cloud
2.5D Depth Map
Enhanced 2D Images

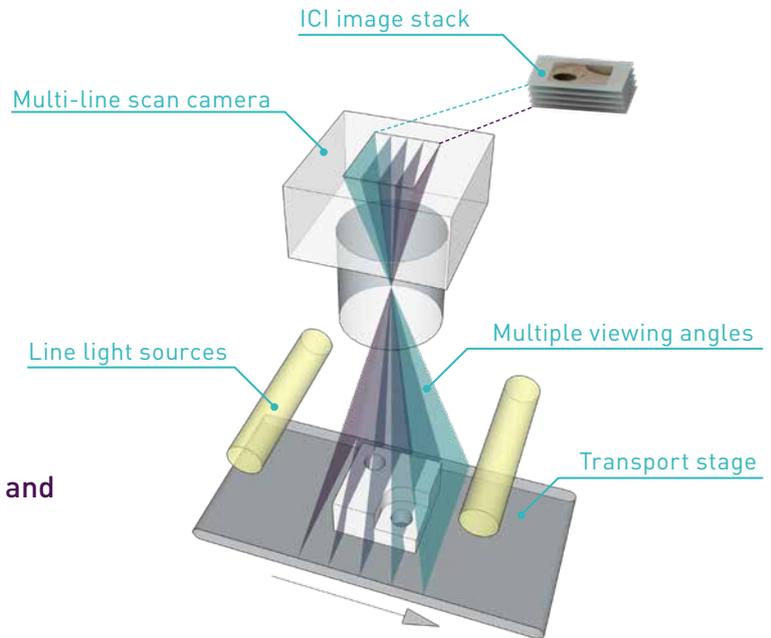


INLINE COMPUTATIONAL IMAGING

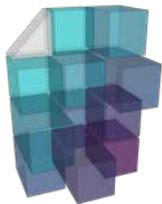
Inline Computational Imaging (ICI) is a novel single sensor technology capable for simultaneous 2D and 3D inline inspection. It combines the advantages of light field imaging and photometric stereo into one compact solution. ICI technology is a new type of image acquisition system combined with smart algorithms for high resolution and high speed 2D and 3D inspection.

AIT ICI SENSOR SYSTEM

The ICI sensor system consists of one multi-line scan camera fitted with a standard endocentric lens, two line light sources and a moving sample part. Each of the lines act as an individual line scan camera that captures the corresponding image line by line while the object moves underneath the camera. This results in an ICI image stack consisting of multiple images each seeing the object under a slightly different viewing and illumination angle.



AIT ICI is a smart combination of light field imaging and photometric stereo.

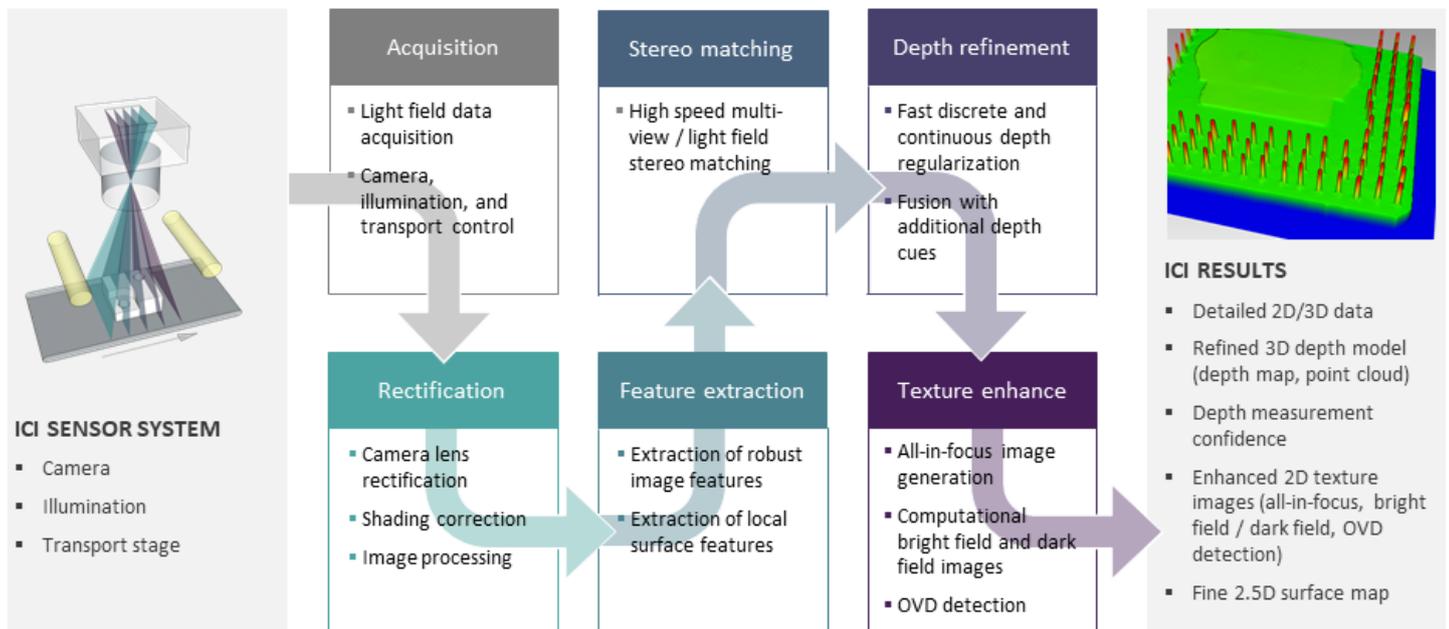


AIT ICI SOFTWARE

The AIT ICI algorithms have been designed specifically to work with the ICI sensor system and provide enhanced 2D images together with a high definition 3D reconstruction. All algorithms are highly optimized for high processing speed and best results quality. They are largely independent from computer and imaging platforms and support decentralized processing and reporting.

AIT ICI is a new technology for high resolution and high speed 2D and 3D inspection.

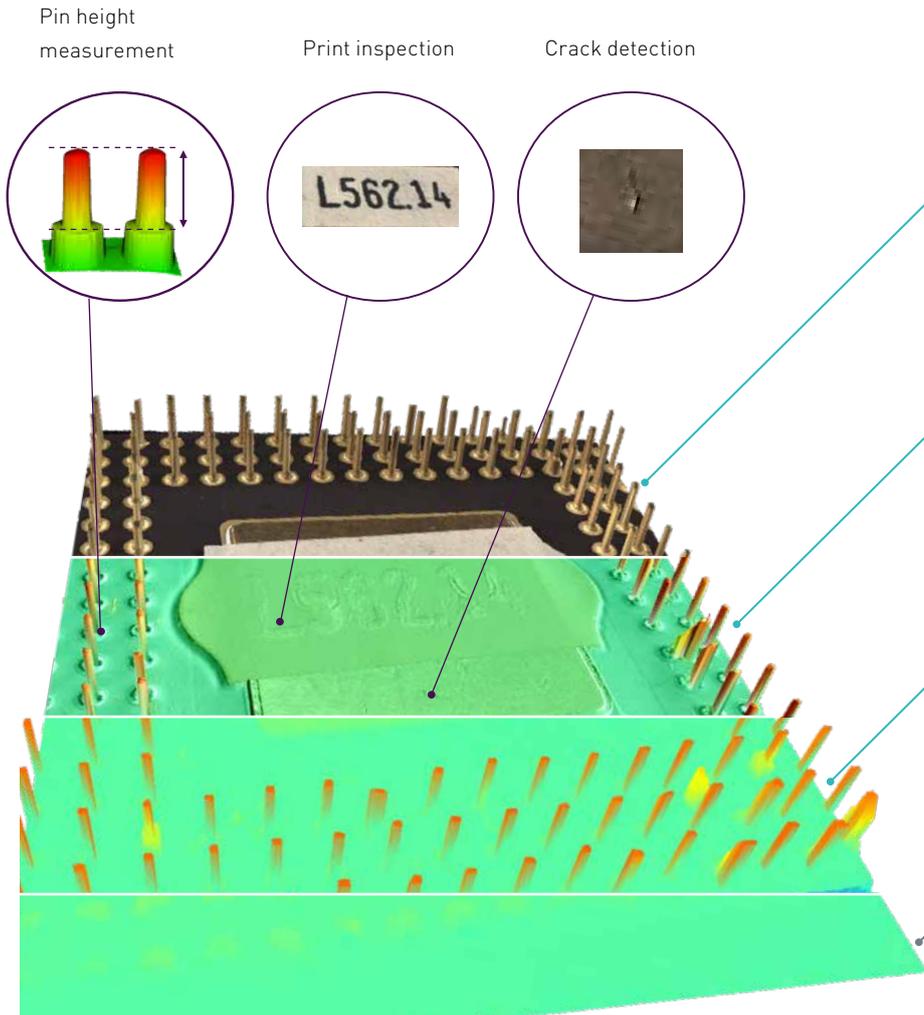
AIT ICI PROCESSING PIPELINE



INLINE COMPUTATIONAL IMAGING – BETTER, FASTER, STRONGER, ...

Inline Computational Imaging makes use of multiple viewing and illumination angles simultaneously. By using Inline Computational Imaging, it is possible to solve problems and tasks where traditional industrial imaging systems fail.

HIGH DEFINITION 3D RECONSTRUCTION



INLINE COMPUTATIONAL IMAGING

- Increased signal-to-noise ratio
- Enhanced 2D imaging
- Flexible dark / bright field imaging

LIGHT FIELD & PHOTOMETRY

- 3D from multiple viewing and illumination angles
- Globally correct and high details
- Robust for all material types

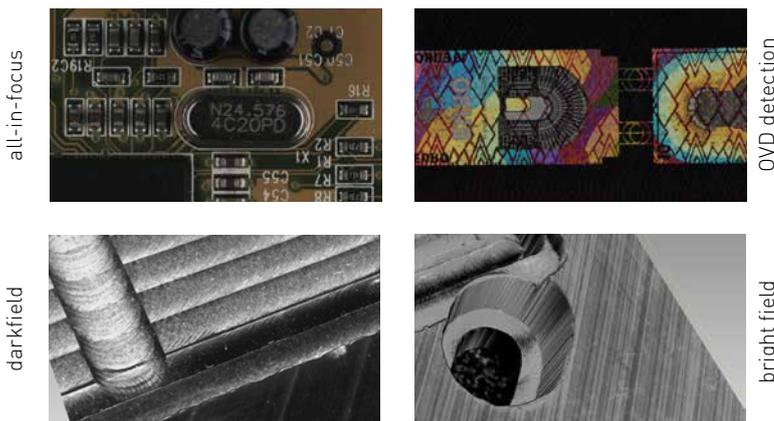
LIGHT FIELD ONLY

- 3D from multiple viewing angles
- Globally correct but low details
- Robust for many material types

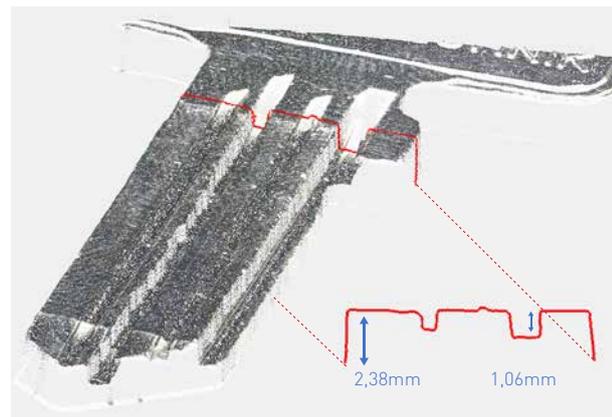
State-of-the-Art Stereo

- 3D from 2 viewing angles
- Error prone and low detail
- Difficulties with dark and reflective materials

COMPUTATIONAL IMAGE ENHANCEMENT



PRECISE 3D MEASUREMENT



FLEXIBLE AND SCALABLE FOR INDUSTRIAL NEEDS

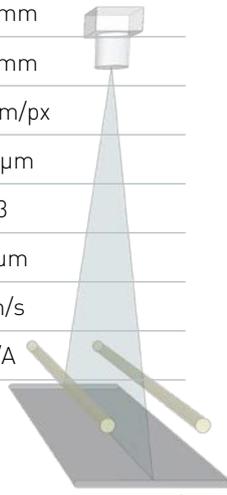
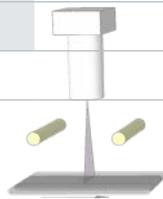
The AIT ICI technology can be tailored to fit various applications and meet their specific requirements concerning optical and depth resolution, working distance and acquisition speed and result quality. The optical configurations listed below provide possible examples for standard, micro and large scale 2D & 3D inspection with AIT ICI.

SCALABLE OPTICAL RESOLUTION

	STANDARD SCALE	MICRO SCALE	LARGE SCALE
Sensor	Multi-line scan 2k	Area scan 2k	Multi-line scan 2k
Optics	45 mm f/4	10x microscope NA = 0.28	20 mm f/2.8
Working Distance	108 mm	34 mm	590 mm
Field of view	46 mm	1.6 mm	464 mm
Depth range	7.2mm	160 µm	700 mm
Lateral Sampling	20 µm/px	700 nm/px	200 µm/px
Lateral Optical Resolution	42 µm	4 µm	420 µm
Optimal Number of Views	13	17	33
Depth Resolution	19 µm	10µm *	1 µm
Max. Acquisition Speed	500 mm/s	250 mm/s	2 m/s
Depth Sensitivity **	< 8 µm	N/A	N/A

*) increased depth resolution via double-oversampling in the transport direction

**) using Multiplexed Light



All numbers are in accordance with the „Fair Data Sheet“.

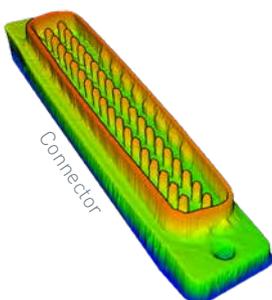
FLEXIBLE TO CHANGING REQUIREMENTS IN SPEED AND ACCURACY

The AIT ICI technology is a multi-line-scan technology which works with any number of lines. This makes the technology easy adoptable for varying speed and accuracy requirements just by changing the number of constructed views. The more views, the higher the accuracy, lower number of views enable for higher inspection speed.

High number of views are ideal for inspection of

- Complex geometries
- Shiny materials
- Challenging tasks

13 views | 500 mm/s | 20µm/px



1 € coin

High speed can be used for inspection of

- Flat and textured objects
- Printed matter with embossing
- Security print inspection, holograms

3 views | 2000 mm/s | 20µm/px



Embossing

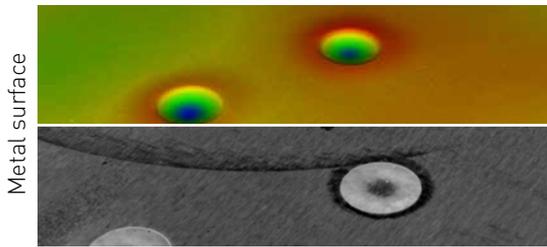


Packaging with braille

... SMART INSPECTION WITH ICI:INSPECT



INLINE COMPUTATIONAL IMAGING CAN BE USED FOR ...

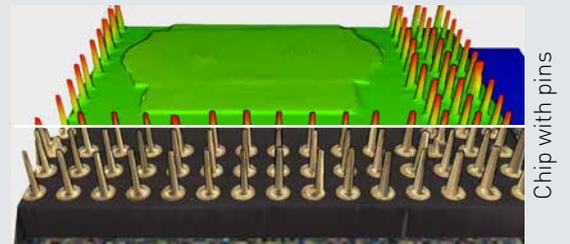


METAL PARTS

- Robust solution for metallic surfaces due to several viewing angles
- Simultaneous 3D measurement and surface quality inspection
- Crack, pore and scratch detection
- Distinguish between machining traces and scratches, cracks, etc.

ELECTRONIC PARTS & PCB INSPECTION

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

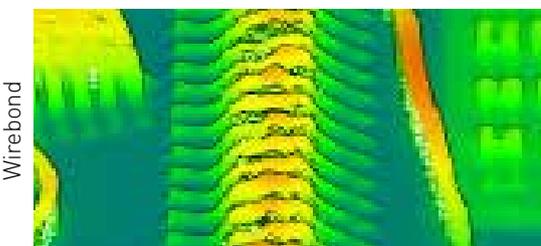
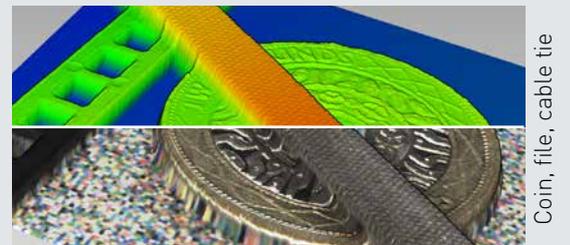


SECURITY PRINT INSPECTION

- Inline hologram inspection, including to check for the correct color shifting effects
- Quality inspection of intaglio print and tactile elements (3D depth)
- Inspection of embossing, braille writing, seals, etc.
- Inspection of decor elements

INSPECTION OF CHALLENGING MATERIALS

- Robust solution for challenging objects, like highly glossy, unstructured and even dark materials
- High quality 2D and 3D inspection with one system
- Flexible parametrization for inspection speed and accuracy
- Works well with challenging reflectance properties

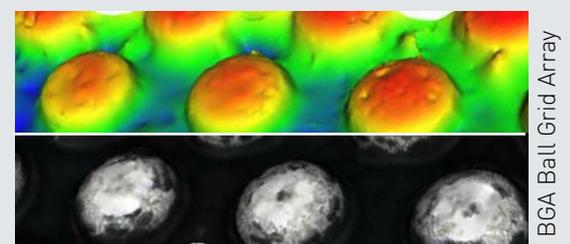


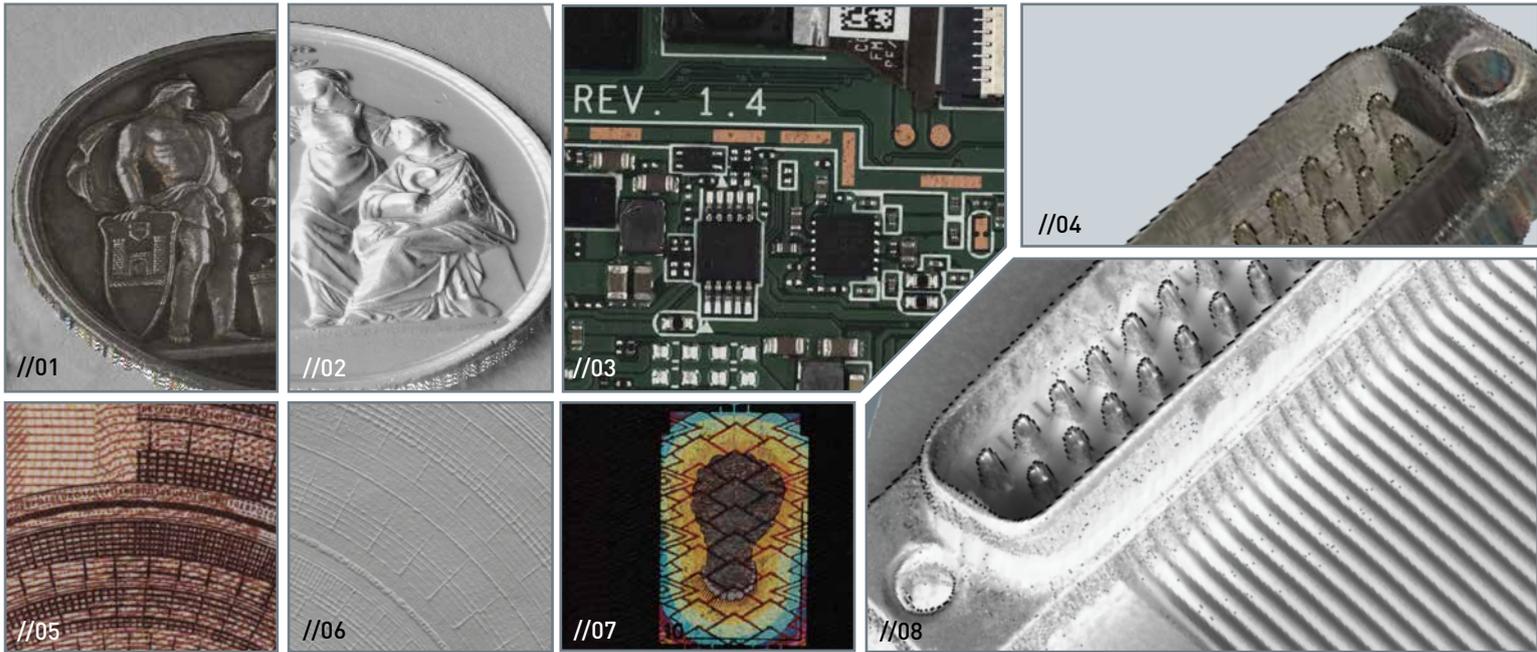
INSPECTION OF COMPLEX GEOMETRIES

- Inspection of complex geometries and thin/repetitive structures
- Wire bond inspection
- Connector pin inspection

INSPECTION OF MICRO-STRUCTURES

- Ball grid arrays
- PCB traces
- Solder spots





ICI:INSPECT IN A NUTSHELL

- Easy - to install, use and maintain.
- Flexible - to changing requirements in speed and accuracy.
- Robust - against variations within the production process.
- Reliable - for high system availability.
- Multi modal - for simultaneous 2D and 3D inspection plus enhanced 2D imaging.
- Universal – works with different materials, no matter if matt, glossy, bright or dark.

METAL

- //01 Coin 3D + texture
- //02 Coin 3D

ELECTRONIC

- //03 PCB all-in-focus image
- //04 Connector 3D + texture
- //08 Connector 2.5D

SECURITY PRINT

- //05 10 € banknote detail
- //06 10 € banknote intaglio print
- //07 10 € banknote Hologram



PRICE-WINNING TECHNOLOGY:

Inline Computational Imaging was awarded TOP INNOVATION 2019

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