AIT AUSTRIAN INSTITUTE OF TECHNOLOGY

COMPUTATIONAL IMAGING

Computational imaging in high performance inline inspection provides a number of new opportunities for industrial inline quality inspection and several fields of application

APPLICATIONS

- 3D measurements down to µm range
- detection of defects / fine structures on surfaces
- material classification (e.g. metal vs. plastic)
- inspection of optically variable devices in security printing (e.g. holograms)

ADVANTAGES

- Many viewing angles with a compact multi-linescan setup using a single camera and illumination
- Suitable for high-speed inline applications
- Precise 2.5/3D surface reconstruction
- Computational imaging for increased signal-to-noise ratio / extended depth of field / extended dynamic range / flexible dark-field bright-field imaging
- Flexible choice between accuracy and speed (can be chosen dynamically)
- Technology protected by a number of patents

INLINE COMPUTATIONAL IMAGING

Computational imaging is a fast growing new research field combining new image acquisition technologies with intelligent algorithms. The aim is to extract image information which could not be derived by conventional machine vision. Light field and photometric stereo are two prominent examples for computational imaging.

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. This technology uses more than two object views in combination with advanced algorithms and therefore allows for more accurate and robust calculation of depth information.

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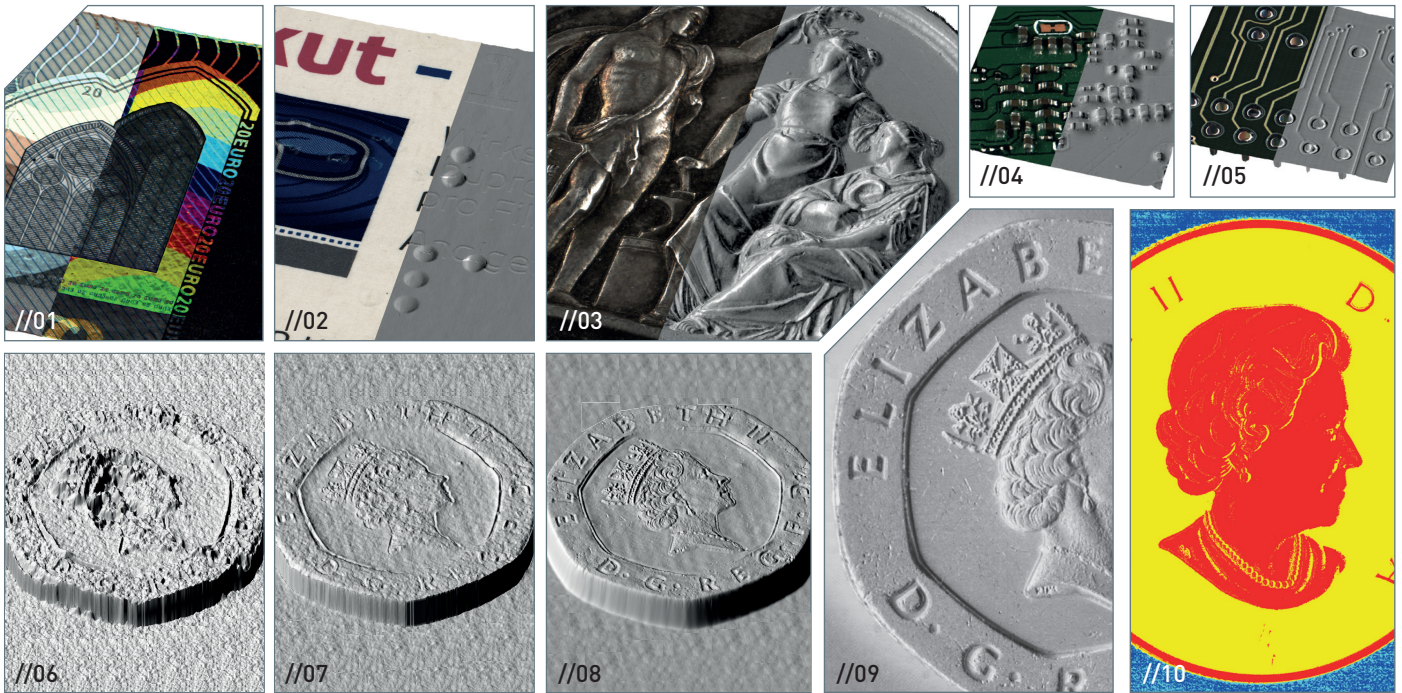
Instead of using several cameras or a microlens array on the sensor chip (reducing optical resolution), our inline computational imaging approach uses only one multi-linescan camera which simultaneously captures several object views exploiting the relative motion between camera and object. By high-performance computational processing of the light-field data it is possible, e.g. to derive depth information and obtain all-in-focus image with increased signal-to-noise ratio.

This approach provides in addition a photometric stereo setup as not only the viewing angle but also the illumination angle varies due to the relative movement between illumination and object. By analyzing the reflectance properties the slope of the object's surface as well as information about its material can be obtained.

Both methods complement one another enhancing the overall accuracy and robustness. By choosing the number of viewing angles, the user can decide dynamically on the ratio between speed and accuracy.

APPLICATION FIELDS

//01 Security feature
//02 Packaging
//03 Coin
//04 PCB with components
//05 Bare PCB

SCANNING RESULTS

//06 Conventional stereo
//07 Light field only
//08 Light field + photometric stereo
//09 Fine surface structures provided by photometric stereo
//10 Material classification
      blue = matt | red = semi-glossy | yellow = glossy