

## xposure:1M

//01 Camera raw image with AIT's shading correction,  
no stitching artefacts

### MEGA FAST LINE SCANNING WITH 1 MHZ PLUS VIRTUAL LINE RATE

The AIT Austrian Institute of Technology 1MHz+ “virtual line scan camera” is a revolutionary solution for modern machine vision applications. It offers unparalleled speed and precision.

#### THE INNOVATION

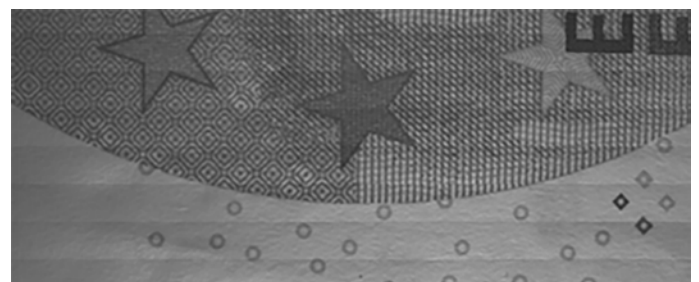
With today's CMOS image sensor technology, area sensors are available that offer scan rates many times faster than the quickest line sensors in terms of lines captured per second. AIT extended the FPGA logic of an off-the-shelf camera with built-in real-time processing which precisely synchronizes the area scan with object motion, seamlessly stitching the scans into a continuous image stream and correcting unwanted shading artifacts (such as “venetian blind effects”) within the camera.

The innovation is that AIT has extended an off the shelf area-scan camera with 1920 x 1080 pixels with special FPGA functionality for image stitching and precise synchronization with ultra-fast strobed LED lighting. This results in unprecedented scanning speeds equivalent to a line-scan camera with 1 MHz line-rate. The used camera comes with a 10G SFP+ interface enabling fiber-optic transmission. Due to its high electromagnetic immunity and cable lengths of up to several 100 meters, it is ideally suited for industrial applications.

The modified camera's optical interface resembles that of an area camera, but outputs quasi-line images that can be used without post-processing. This is made possible by an intelligent stitching function integrated into the camera's powerful FPGA, which still leaves capacity for future enhancements, such as colour imaging at up to 500 colour lines per second (Bayer pattern), managing captures from multiple light sources for photometric stereo, or increasing sensitivity through

overlapping area image reads (“Multi-TDI”). This novel capture technology paves the way for the future of high-speed image acquisition for uniformly moving objects.

A significant advantage of this new capture technique lies in the illumination design. At such high scan speeds and with extremely short exposure times of around 1  $\mu$ s, sufficiently strong illumination of the object is crucial. With today's high-power LEDs, the light output can be significantly increased by overdriving when pulsed with a small duty cycle. This applies when illuminating the area camera's field of view, as the exposure time must be a fraction of the frame period to avoid motion blur. This means that the light source only has to be switched on for a short part of the cycle. AIT's fast strobed line light technology xposure:flash with pulse durations down to 1  $\mu$ s is a possible illumination solution.



//02 Camera raw image without shading correction  
stitching artefacts are clearly visible

## xposure:1M the new solution ...

### APPLICATION FIELDS

- **Wire Inspection:** Enables high-precision, real-time inspection of wires, detecting even the smallest defects. At production speeds of up to 100 m/s, a resolution of 100  $\mu\text{m}$  per pixel can be achieved.
- **Print Inspection:** Monitors printing processes at the highest level to ensure that every print is flawless and of the highest quality. At 10 m/s, a resolution of 10  $\mu\text{m}$  can be achieved.
- **Electronics Inspection:** Provides detailed monitoring and analysis of electronic components to identify defects early and ensure product quality. At 2 m/s, a resolution of 2  $\mu\text{m}$  can be achieved.
- **Surface Inspection:** Examines surfaces for scratches, cracks, and other irregularities to ensure flawless final quality. Even when using photometric stereo, utilizing pulsed light from four different directions, a resolution of 40  $\mu\text{m}$  can still be achieved at 10 m/s.
- **Battery Foil Inspection:** Inspects electrode foils for battery production, focusing on defects such as critical peaks and agglomerations to prevent future short circuits, which are highly relevant to product quality. Photometric stereo with four lighting directions can be utilized at 5 m/s, achieving a resolution of 20  $\mu\text{m}$ .

### TECHNICAL DATA

#### AIT FPGA module covers

- High speed line read out
- Stitching for output frames of max. 1080 lines
- Compensation of stitching artefacts (venetian blinds effects)

→ VIRTUAL LINE SCAN RATE >1MHZ

Currently supported sensor types: monochrome

### xposure:1M IN A NUTSHELL

The 1MHz+ virtual line scan camera offers unmatched speed and precision, along with versatility and ease of use.

This innovation opens up a new range of applications for fast moving products.

Thanks to its previously unattainable combination of resolution and speed it will make a significant contribution to the advancement of various industries.

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... for mega fast inline inspection.