CUSTOMER STORY

Process and Quality Optimized Foil Manufacturing

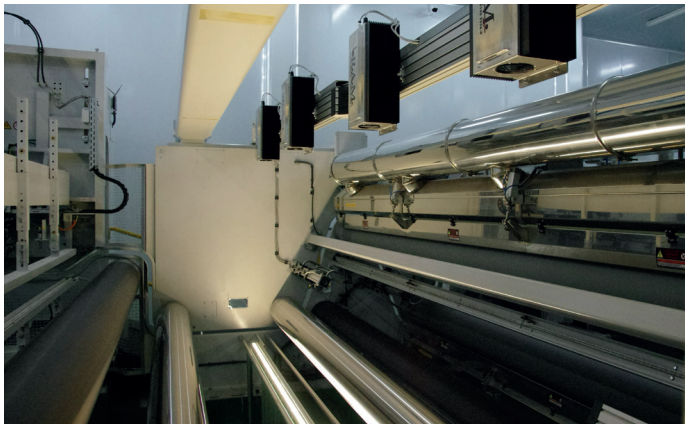
When it comes to the manufacturing of band material such as foils it is essential to deliver an error-free quality to the end customers to avoid returns and expensive reworking. To achieve this, it is required to analyze the foil's surfaces dependably on defects already in the production and to initiate quality-ensuring activities in time. With the inspections system by R.A.M. GmbH, Germany, in which frame grabbers and software by Silicon Software are integrated, foils can be analyzed area-wide with high resolution, detected defects be differentiated reliably and analyzed in real-time and therefore the processes in the production be optimized.

Customer

- R.A.M. GmbH
- Location: Flörsheim, Germany
- Industry: Foil Inspection
- Implementation: 2018

Application

The 2k cameras being used so far could no longer fulfill the high requirements regarding speed, resolution and quality of the images and were replaced by up to 16k CMOS line cameras with integrated suitable frame grabbers. These cameras allow a resource-saving image preprocessing already on the FPGA processor of the frame grabber. With a single 8k camera very small defects can be detected, which is enough to completely find defect sizes from 0.2 mm which are common for foil material. For even higher resolutions it is in addition possible to install a parallel setup of several 4k, 8k or 16k cameras with frame grabbers connected per Ethernet.



Foil inspection system with 4x 8K cameras for the analysis of a 5.50 m large foil / Photo: R.A.M.

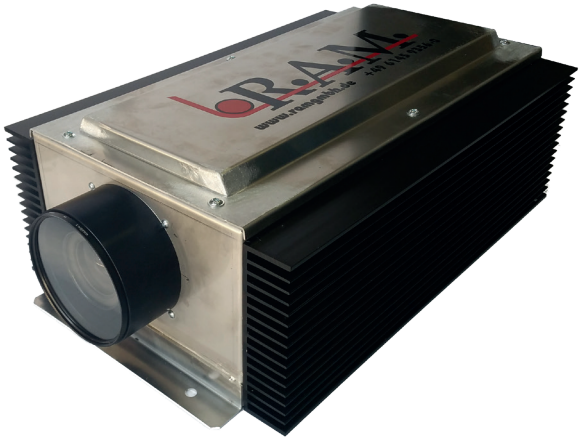
Solution and Benefits

Analysis of 40,000 lines per second

To find defects on and in band material, the inspection system scans the complete front and back side of the foils with possible web widths of 50 mm to 10 m with a camera resolution of e.g. 81.920 pixels in CD (cross direction) by parallel connection of five 16k cameras. This parallel connection can be enhanced optionally and adapted to customer requirements. By this, the system reaches a sample rate of 40,000 lines per second easily. As lighting sources are available fluorescence and LED line luminaires for shining-through light, bright field, dark field or incident light. Beside frame grabbers for Camera Link meanwhile the more powerful frame grabbers for CoaXPress are used. The FPGA processor on the frame grabber can be programmed by the development environment VisualApplets by Silicon Software customer-specifically for special image processing applications. By a sensor correction for example the acquired pixels are sorted in the right order. Another application counts and classifies the detected defects. Software developers from R.A.M. are able to program the wished functions on the FPGA by themselves, without using a hardware description language. Thus, the company remains flexible towards its customers without the help of external resources.

Programming applications by oneself with VisualApplets

As soon as a plant gets operational for foil manufacturing, the line cameras compatible with the plant are brought on line. The high-resolution CoaXPress grey scale cameras with 8 bit image depth analyze for each pixel of the moving band materials 256 different grey scales as thresholds. Have the pixel tolerance area of very high (= bright) and very low (= dark) values and therefore the respective threshold been exceeded, the point on the foil is considered as being defected: A too bright area will be identified as a hole, a too dark area for example as a stain. The four thresholds in total for bright/dark irregularities have been programmed by R.A.M. in VisualApplets using lookup tables. At the detection of defects the camera transfers instead of the whole line image only the affected defect area for a detailed and resource-saving analysis. This function could in future also be realized in VisualApplets. Should the memory of the frame grabber be at capacity limit by calculation- intensive tasks such as the pixel analysis over thresholds and lookup tables, it can be enlarged by the frame grabber add-on unit Pixel Plant by Silicon Software. By this, the cutting of defected areas is additionally controllable.



Modular camera for the optical control of web surfaces
Photo: R.A.M.

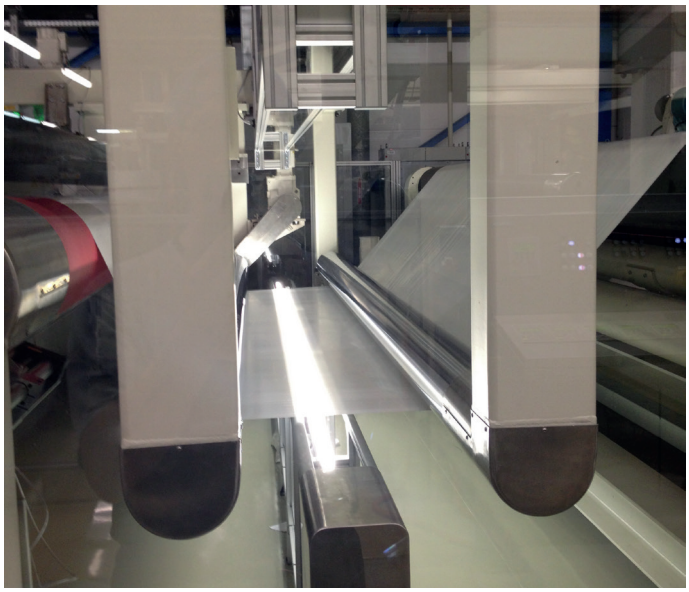
Classifying and analyzing defect images

The inspection system disposes of digital inputs (e.g. for roll change signal, rotary encoder signal or inspection stop signal) and digital outputs (e.g. for the driving of the alarm lamp at critical defects respectively a certain defect quantity per sq. m., plant stop). Optical defects are automatically classified according to defect classes, such as spots, scorches, fish eyes, impurities, inclusions or flies, and are continuously displayed as images and also in symbolical and graphical view. Grey-scale images of these defects (display of defect details) are at disposal for further analysis.

The R.A.M. process control software CAMEN (Computer Aided Manufacturing Environment) supports operators to typify defects by using defect images shortly according to opacity, haze and transmission and then based thereon to sort them according to classes. By an alarm function they have the possibility to intervene shortly into the production. A classifier defines automatically the inspection parameters for the single defects. By the inspection record PAT (Post Analysis Tool) by R.A.M. the distribution of defects is exactly displayed on a screen. This enables a post-analysis of the defect images, data and attributes. Accumulations of defects can be determined very fast and appropriate measures be initiated in the production.

Optimized quality assurance at foil manufacturing

“The collaboration between R.A.M. and Silicon Software leads to a higher quality at foil manufacturing”, explains Thorsten Weidenfeller, Head of Development at R.A.M. GmbH. Defects on foils can now be detected and classified in the required high resolution and within a certain tolerance range in high speed and be processed by the analysis and inspection tools in no time. The extremely short exposure time of the camera with 25 µs allows reaching high band velocities for a higher data throughput. “The comprehensive analysis tools allow for detailed conclusions on the defect causes and support the process optimization of the plant. Therefore, a consistent quality assurance in the production is boosted”, underlines Weidenfeller. R.A.M. is able towards its customers to offer systems with integrated cameras and frame grabbers, and to program on the thereon included FPGAs specific image processing applications with VisualApplets in short time and as often as required by their own software developers. The pre-analysis of the data in the FPGA without an additional computer reduces the data quantity on the frame grabbers, which increases the overall performance. The training expenditure for the programming with VisualApplets is only about one day considering existing previous knowledge. “Necessary software changes can be realized independently and updates for the camera system shortly be provided. This is a big plus for us and our customers”, says Weidenfeller.



Foil inspection system in a biaxial line / Photo: R.A.M.

Technologies Used

- microEnable 5 marathon VCX-QP for high-speed-image processing
  - Up to four CoaXPress cameras with a bandwidth of 25
  - Gbit/s
  - DMA 1800 / up to 1800 MB/s PCIe Data bandwidth
  - (PCIe x4 Gen2)
  - Custom FPGA programming with VisualApplets supporting
  - Xilinx Kintex FPGAs
  - Industrial multi-device, multi-camera support
  - Supports opto-decoupled signals via front I/O
  - Broad support of Third-party software interfaces



microEnable 5 marathon VCX-QP

More Information

http://www.ramgmbh.com

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