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Control for Perfection in High Resolution Single Pass Printing: First Wide Format Scanner for Process Monitoring of Digitally Printed Decor.

Baumer Inspection

Baumer Inspection GmbH, based in Konstanz Germany, is specialized in optical inspection machines for 35 years. Baumer Inspection has installed more than 500 systems world-wide for the décor printing and the wood based panel industry. The ColourBrain® inspection systems combine a plurality of camera/ illumination/software modules to mimic the specific perception of the human eye for multi-colored and complex patterned surfaces.

1 Automatic optical surface inspection for digitally printed decor.

Since years, drop on demand printing technologies for digitally printed décor are hot subjects at printing conferences and printing exhibitions. Today a lot of installations of single pass printing lines are showing good performance in the production lines of foil and paper as well as on flooring and furniture boards.

Baumer Inspection GmbH, as a leading producer of scanners for automatic inspection of multi colored surfaces, does follow those developments very close. We are sure digital printing technologies will replace part of gravure printing in future, especially having in mind the ongoing reduction of volumes of print orders.

We also are aware that the extremely high amount of printing nozzles in single pass printing will cause printing flaws with high statistical probability. We are convinced, the high demands on the surface quality of the substrate, on the mechanical perfection of the printing system and a big number of influencing parameters of the printing environment, need to be permanently monitored by an optical process control system to safeguard a stable and reliable printing process.

2 Process monitoring and process optimization on single pass printing


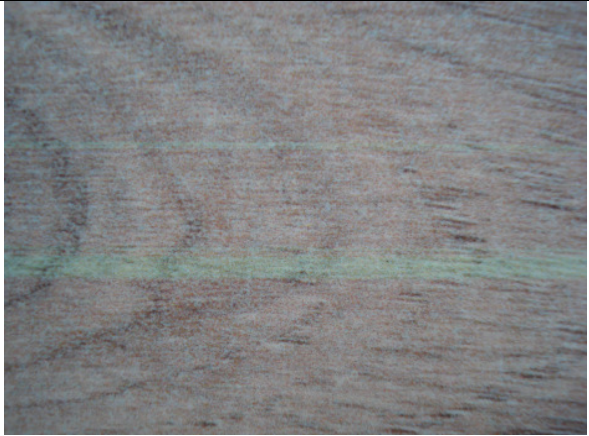
Since three years Baumer Inspection works on the development of a scanner system for the process monitoring and process optimization in single pass printing lines. By the same time we are financing a PHD and a group of master and bachelor students at the Polytechnic University of Konstanz.

From the start, we are working in a very close cooperation with customers of us to synchronize our specifications for the inspection systems in the best way possible with their needs and expectations. The scanner shall safely detect all flaws and drifts during the single pass printing process, give early alarms in case of drifts and shall prevent production of rejects by permanently analyzing the quality of the printing process.

Based upon a lot of samples and pre-tests, the basic specifications for that new inspection system are defined as:


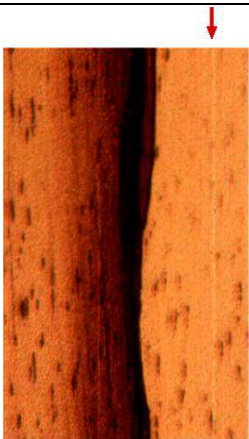
- Safe detection of all flaws like nozzle outs, printing head problems, color spots or problems with the substrate. Inline at single pass printing speed of up to 150m/min and for print resolution of 720dpi.

- Monitoring the color consistency from printing head to printing head and the control of mechanical adjustments of printing heads, inline and all over the width of the printing machine.
- Analyzation of the visibility of printing problems and printing flaws. Automatic strategies to improve productivity in case of detection of nozzle problems.
- Classification of defects and tools to analyze data and images in order to improve the printing process.

	
Printing head problems	Nozzle outs
Examples of flaws in digitally printed décor.	

Our analyzation of many nozzle problems has proven that many of those lines caused by nozzle outs are not to be seen by the human eye. Those defects are hidden in the décor, depending on the type of décor, on the position of the nozzle and the local contrast on that position and of that decor.

For this reason, the ColourBrain®DoD scanner design has a new specification for the way of grading the visibility of defects detected. The target of this grading of the visibility of defects is to improve the productivity of a single pass printing line. Only those defects which are beyond quality criteria of the décor printed on this print job should lead to a stop or interruption of production.

		<p>Example of nozzle outs:</p> <p>„Black“: with low visibility in a dark wood decor.</p> <p>„Magenta“: with a high visibility in a bright decor.</p>
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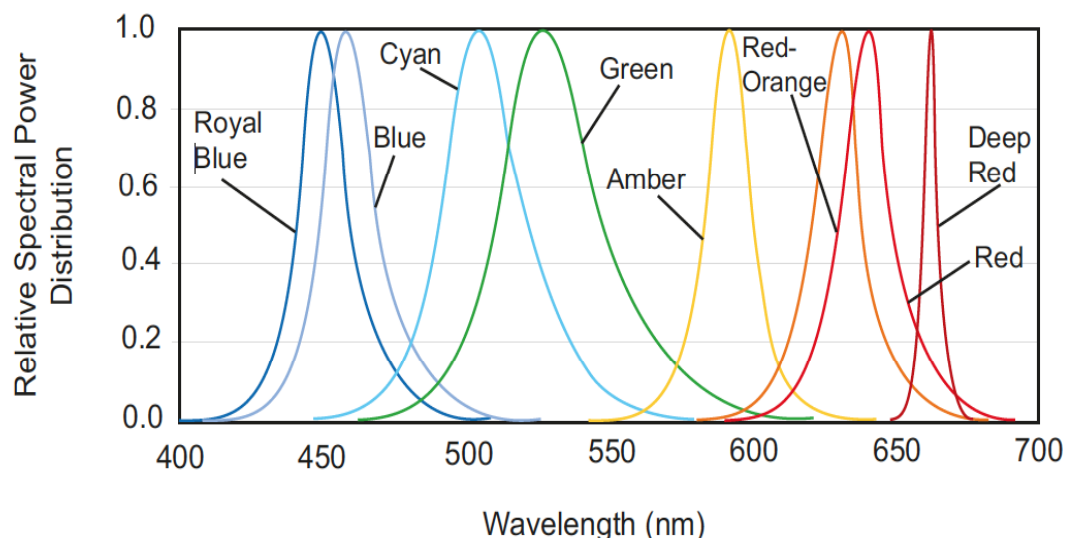
The automatic optical inspection, much more sensitive as the human eye, will detect every nozzle problem. After detection, the new ColourBrain®DoD scanner will automatically grade the visibility of defects by special algorithms which mimic the human perception. To optimize this analyzation, the second University to assist the PHD project is the Eberhard Karls University in Tübingen, which is specialized on projects regarding the way of human perception.

3 The specifications and the design of the system

Based on considerations and analyzations mentioned above, we specified the system:

- 1 Automatic inspection without referencing to RIP files data.
- 2 Inspection for single pass printing with up to 150m/min printing speed and 720 dpi print resolution.
- 3 Modular design to be adaptable on all width of printing machines.
- 4 Detection of printing problems during print job:
 - Detection of all nozzle failures like missing nozzles, blocked nozzles, flashes, etc.
 - Detection of problems in synchronization.
 - Detection of blocked printing heads.
 - Detection of smearing, drops, spots, streaks, etc.
- 5 Monitoring Color consistency:
 - Color consistency for all printing heads all over the width of web.
 - Stability of color all along the printing job.

To achieve the target of being independent from RIP information, the scanner has a design of cameras and illumination which gives a perfect contrast for all nozzle problems, independent of any décor. Numerous tests with LED illuminations of small band width have proven that this target could be achieved by special illumination systems with LEDs of small spectral band width in correlation to the ink colors of the printing system.



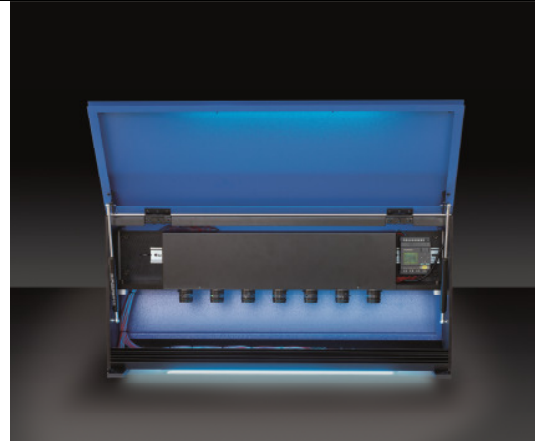
Based upon those pre-tests, the system is designed with four LED illuminations of small spectral band width.

The backbones of the mechanical design are Baumer Inspection's proprietary cameras. Those cameras have a special on board pre-processor which is the precondition to analyze the extremely high data rate of image data acquired from digitally printed décor in real time. The newly designed

cameras also are much more sensitive and the combination of high sensitivity and fast on-board analysis gives way to inspection at a resolution of 35µm on production speed of 150m/min.

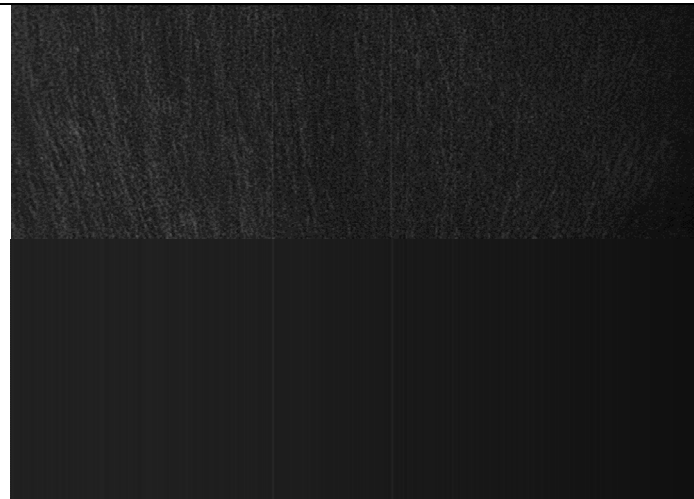
Tests with a Prototype

Baumer Inspection designed and produced a first test system which has been installed at four different single pass printing lines.



Prototype of the Scanner for high resolution inspection on digitally printed decor.

The results of those test installations have proven the concept and have shown a very good contrast and sensitivity for single nozzle problems.



Wood décor with different nozzle problems of different visibility.

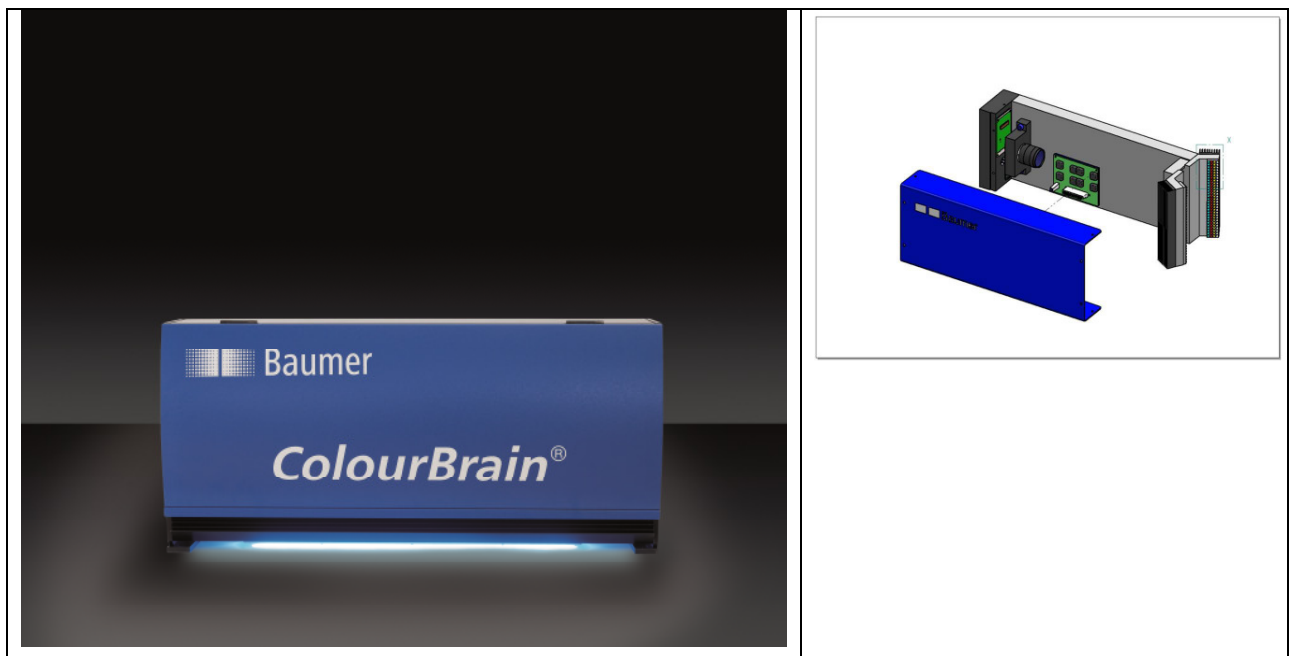
The wide format scanner

Baumer Inspection got the first purchase order for a high resolution scanner for single pass printed décor. This ColourBrain®DoD scanner, with a field of inspection of 2.250mm, will be installed within the next 8 month in a production line of digitally printed flooring boards. This scanner will operate at production speed up to 50m/min and with print resolution of 720 dpi.

Based upon the specs mentioned above and the results of the test installations, the design of the wired format scanner for inspection of digitally printed décor is like:

- High speed flashed LED narrow band line illumination systems, in colors like ink colors.
- Modules with very high resolution for print inspection up to 720dpi.
- Array of very fast line scan cameras, proprietary of Baumer Inspection.
- Integrated FPGA for real time image pre-processing.
- Integrated controllers for LED flash illumination.
- Integrated vision computers for real time image processing.
- Precise mechanical design with optical bench on total width of inspection.
- Algorithms for detection of print problems without RIP file information.

This scanner also will classify nozzle problems detected and grade the visibility of all defects.



Corporate Data Baumer

Baumer Inspection GmbH, based in Konstanz Germany, is specialized in optical inspection machines for 30 years. Baumer Inspection has installed more than 500 systems world-wide and is a leader in fully automatic optical defect detection and process control in the woodworking and panel industry. The Baumer's choice of products includes camera systems for decor paper and decor foils, furniture boards in the short cycle press line, after lamination or lacquering, laminate flooring and surfaces or edges of furniture panels.

Baumer Inspection is integrated in the Swiss Baumer Group, a worldwide leading company for innovative and high quality sensors and systems for the process automation. With over 2500 employees worldwide and 250 in the field of industrial image processing and vision sensoric, Baumer belongs to the leading companies in the vision industry.

Our customers profit on an international scale of our wide range of products together with a holistic consultancy and a reliable service.