Using Machine Vision Based System for Benchmarking Various Printing Plate Surfaces

Eugene Langlais[1], Shiva Adudodla[1] and Prashant Mehta[2]
[1]Presstek Inc., [2]ImageXpert Inc.
Nashua, New Hampshire

Abstract

Traditionally a dot meter or an optical microscope fitted with a camera is used to analyze the dot position and dot area fraction of offset plates. Dot meters do not provide valuable information such as dot raggedness and dot positioning. These features are important when the plates are exposed digitally using laser diodes. The alignment of individual laser diodes is very important for controlling the position of the dots and in turn controlling the moire patterns appearing the final full color prints. Dot position verifies diode quality, alignment, and ensures output quality.

The optical microscope system that was used by Presstek in the past could capture optimal contrast images only of metallic plates. Also, the software that had been used for analysis was only capable of measuring dot percentage and a few dot quality parameters, and could not provide enough useful information about other plate and print quality features. To achieve accurate dot percentage results, the threshold values had to be changed manually for each nominal dot area fraction value. After each analysis, the measurement result of the actual dot area percentage had to be saved manually to a file from the software.

Presstek (a manufacturer of wide range of specialty offset printing plates) deals with plates of different materials, many of which are unique, so a new image inspection system was required to provide the quality assurance necessary across the various product lines. It was recognized that this system needed to be able to successfully measure on various plate media, and be able to adjust threshold values, store images, and save results to a file automatically. It was also necessary for the system to be able to perform various plate and print quality analyses including dot area fraction, dot position, feature location, etc.

An ImageXpert system with a 3-CCD color camera and high magnification optics is now in use. The combination of camera and ring light illumination source is capable of capturing images from various plate materials with excellent contrast. In addition, when co-axial illumination is necessary, images can be captured using our existing microscope and can be imported into ImageXpert for analysis. The software provided with the system is capable of measuring dot area percentage (even in the difficult 50% dot area range) with automatic thresholding, and it can measure dot positions, various dot quality attributes, and perform printability analysis on printed sheet as well as imaged plates.

Introduction

With Presstek technology, the image is formed by laser ablation of a stack of active layers involving materials like silicone, titanium, carbon and ceramic to produce "chemistry-free" offset plates. Each layer serves a different purpose in the whole process of image formation and final transfer of ink to the paper. Image analysis plays a vital role to find the sweet spot within the possible combinations of layer materials and structures, and the laser settings required for reliable ablating of the plate material. With the development of technology, as smaller laser spots are produced on such plates, an instrument that would produce accurate, repeatable and reliable measurements relatively quickly is very important. It is also important that the software used in such instrument is flexible enough so that new sets of imaging system performance parameters can be easily implemented. It was clear that a simple microscope and cross hair generator was not a sufficient solution.

Definitions:
Spot: An area ablated on the plate by firing a single laser.
Dot: An array of connected spots.

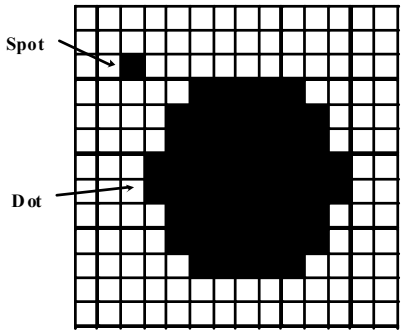

Figure 1. Dot and spots

Considerations

It is very important that any image quality measurement tool provides consistent and repeatable results. The system should be able to provide reliable results at various magnifications and should work satisfactorily with a wide array of dot/spot sizes. Dealing with plates with different backing layers having different reflectivity adds complexity to the image quality measurement process. While most microscopes come with a coaxial light source for higher magnification measurement, our experience shows that use of ring light source for illumination increases the contrast between the image and non-image area of the plate for many plate materials. In practice, there are times when each type of image capture geometry is necessary. A consideration in choosing an image analysis system included the flexibility to analyze images captured from different acquisition devices.

Since there was a large volume of measurements to be performed, it was clear that automation in image quality measurement software was key to generate meaningful data in the shortest amount of time. A friendly user interface was necessary to make the system easily adaptable and usable by those with basic computer operation skills.

The software that had been available at Presstek only allowed measurement of dot percentage and a few more parameters but a threshold value used for one dot percentage will never work for other dot areas. And, threshold values had to be sent manually for each measurement. The setting of a threshold value was highly subjective and it was clear that this subjectivity had to be removed from the current measurement methodology. The software could not be automated easily which made it very clear that an easily automated system would be a better solution.

The choice of which image quality measurement software was made based on thorough testing of the software, its reliability, repeatability and ease of automation. Once it was established that the variations in measurements produced using the ImageXpert software were within acceptable limits, a purchase decision was made. The software is now used for both the older analytical methods and for many new applications as well. The following sections describe some of the applications that are in use today.

Spot and Dot Quality

Spots are the smallest units produced by a laser beam and the quality of the spots determines the quality of dots (made of spots) and the quality of printed images. Spot size and position defects on the plate are prime causes of moire patterns in printed images. The common parameters considered for evaluation of both spots and dots include horizontal and vertical extent, area, roundness, distances between dots in the same row or column, and box area ratio. ImageXpert allows for all of these parameters to be measured simultaneously and also provides statistical analysis if required. Macros were configured to automate the whole measurement process.

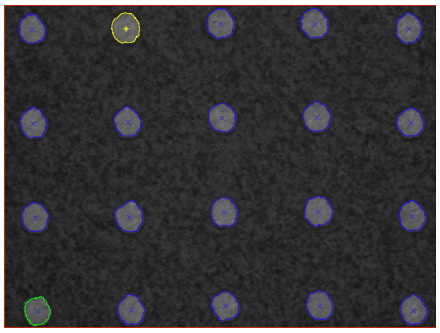

Figure 2. Measurement of spots

Edge Quality

Smoother and less ragged lines on a plate result in higher quality printed lines and pleasant image appearance. Therefore, edge raggedness is an important parameter when benchmarking the performance of any plate coating material. The raggedness of an edge is caused by many factors such as the laser stability, spot shape, spot overlap and evenness in ablation of the layers of plate material. A better plate material layer and laser ablation process combination will produce sharper edges. Measuring the raggedness of a line to determine quantifiable values during research and development aids in the evaluation of test plates.

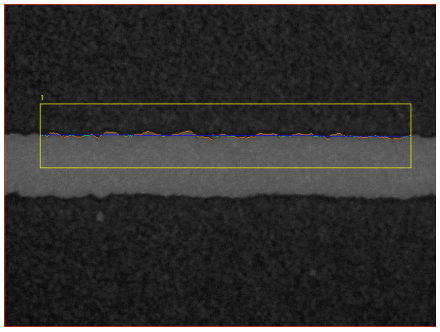

Figure 3. Edge quality

Distance Between Dots or Spots in the Same Column or Row

A pack of diodes is used to produce laser light for ablating the plate layers. The average distance between spots produced by different diode packs may vary and could result in serious banding when the plates are used in printing. The measurement system is useful for analyzing the difference between average spot to spot distances for each diode pack. In the diode packs that are used for production, the distance between individual diodes is nominally constant, but when working on new prototypes the ImageXpert measurement system is useful for quantifying the variation in diode spacing.

Laser Alignment and Pack Overlap

In an imaging system with an array of diode packs arranged next to each other, the alignment of these packs is also critical and the highest degree of accuracy is required

to get a smooth shift when going from one pack to the next with an equal overlap. So, the measurement of overlap between two diode packs and their alignment is very important. The measurement process automated with the ImageXpert software is proving to be both time saving and efficient for testing purposes.

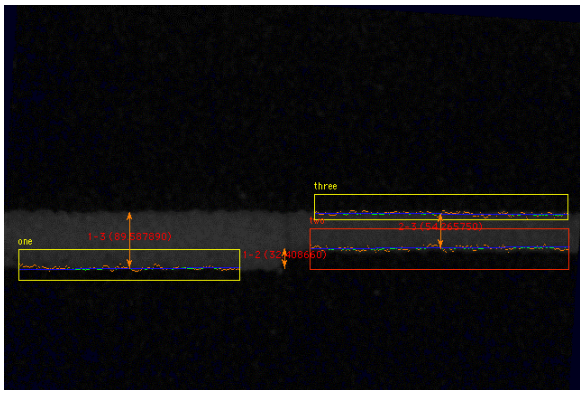

Figure 4. Alignment of Diode Packs

Laser Spot Bandwidth

There is a constant effort to find the best combinations of laser settings and plate materials. For such tests, it is very important to analyze the capability of all diodes to produce sharper and more consistent spots on different plate media.

A series of tests are performed for each combination using different power and pulse widths for the laser energy to image a single pixel on the plate. The ability to measure various spot characteristics is useful to determine the best power and pulse width combination for each plate material. This process involves repetitive measurements and the ability of the ImageXpert software to easily configure macros has made such testing less tedious and less time consuming.

Dot Area Coverage and Dot Area Coverage Variability

One of the most important parameters that indicates the performance of a printing plate is its ability to produce and retain specific dot area coverage during an entire print run.

We have been able to pinpoint the variation in percent dot area coverage during plate life testing. Such tests provide insight into the kind of wear that the plate demonstrates during the print runs. Dot wear in plate will result in low ink density on printed sheet of paper. Accurate results are critical to characterize, communicate, and maintain excellent product quality. Therefore it is very important to use measurement equipment that is reliable and accurate. We have been able to achieve more repeatability and reliability we require by using ImageXpert.

50% Dot Measurements

In our experience with various commercially available instruments for measurement of dot area coverage on the plates, 50% dots are the most susceptible to errors, introduced by the measurement device We have been able to measure this attribute more repeatably and reliably with our current system.

Since all dots are connected to each other in 50% image area (a checker board pattern), it is very difficult to measure individual dot quality characteristics. The masking tool available in ImageXpert software allows user to separate one dot from the others and to perform analysis on characteristics of single dots. This has been extremely useful in product performance analysis and verification.

Measurement Automation

Many image quality measurements are quite repetitive. Often, the only difference between sample sets is the configuration of the laser or the plate material formulation. In such situations, the ability to set up macros without any software programming has made the measurement process much more efficient. Once the macro is set up, many different users can use the same macro to capture and analyze images without having to learn how to use the software in detail. This has enabled a higher number of people in the organization to benefit from these image quality measurement instruments and software program.

Conclusion

In this paper, it has been shown how an automated image quality measurement tool has been helpful in expanding the utility of a current optical microscope and to add image capture and analysis alternatives to produce helpful applications for printing plate quality characterization.

The software has been successful in measuring 50% dot quality and very small size spots - both of which are challenging to analyze using traditional dot meters or other commercially available hand held image quality measurement tools.

Including the use of quantitative analysis in our research and production processes has increased our ability to track the quality of our products and to make more educated choices about system optimization and material performance tradeoffs.

Biography

Eugene Langlais, a surface chemist, has over 35 years of experience in leading product development and manufacturing teams in the graphic arts industry. During that time, he has developed films, proofing systems, and plate products that have emphasized simple processing, operator safet, and environmental soundness. Recently, he has participated in programs that have resulted in infra-red laser imaging “no-process” imagesetter film; “no-process” photopolymer lithoplates; and digital color proofing systems based on phase-transfer ink jet technology as well as laser ablation transfer technology. He has led the R&D operations at Durolith, NAPP systems, SAGE Technology, and POLAROID Graphics Imaging. At Presstek, he has been instrumental in leading the team delivering the “water cleaned” Anthem® laser ablation plate product. The Anthem® plate along with the Dimension® 400 platesetter is the recent recipient of a GATF Intertech Award for outstanding new technology products in the Graphic Arts.