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Verification of a Print Process Simulation Using InfiniteFocus

Measurement of the deposition characteristics of toner particles

InfiniteFocus is an optical 3D surface measurement device for quality assurance in the paper and printing industry. In the area of electrophotographic printing InfiniteFocus can be used to obtain reliable and calibrated data from the deposition of toner on a photoconductor. Based on these measurements verified simulations of toner particles are computed and measured.

The ability to gain reliable data from the real printing process has been a benefit to the German manufacturer Océ printing systems. InfiniteFocus provides an insight into the physical background of the process specific effects to increase speed and resolution of its electrophotographic printers. The use of InfiniteFocus now enables Océ to offer printing systems which are close to offset-like print quality.

The electrophotographic print process is widely used today due to the cost effective relationship of print quality versus page costs. However, the demand for ever higher, more offset-like print quality is rising. Manufacturers in the high volume sector of commercial printing strive to achieve the same quality from electrophotographic printing processes as is achieved with offset printing. With Alicona Imaging, optical measurement and inspection systems, the German manufacturer Océ printing systems has successfully increased the quality of electrophotographic printing processes.

The improvement of these processes requires a better insight in the print process details, particularly the characteristics of a toners' deposition on a photoconductor is necessary. Océ computes mathematical models to simulate toner particles as these simulations avoid expensive and time consuming experiments. However, before a simulated toner deposition can be trusted and used productively it has to be verified and calibrated. In Alicona Imaging, 3D specialist and supplier for optical measurement and inspection, Océ found a qualified partner to realize this complex and challenging task. Using InfiniteFocus, an optical 3D measurement device for surface metrology in the micro and nano range, 3D surface measurements and visualization with full depth of focus of a toner particle could be obtained. Based on these results simulated models were computed (Fig. 1).

With the results from InfiniteFocus the verification of the print process with the simulation could be started. Ten 3x3 pixel size test patterns were printed, measured and averaged and compared with the average of ten simulated test patterns. The actual profile measurement of the deposited toner was very near to the simulated results with a difference of only 7.5%. This is in the same order of magnitude as the error bound of the measurement.

Using InfiniteFocus it was, for the first time, possible to measure the deposition characteristics of toner particles accurately within minutes. The ability to compute reliable simulations of the process of an electrostatic image transfer allows Océ to gain instrumental insight about the physical background of the essential process specific effects. This knowledge allows predictions about the consequences of

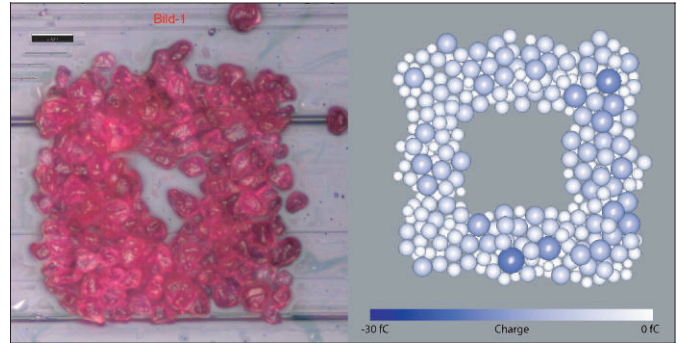


Fig. 1: Data of a toner particle obtained with the optical 3D measurement device InfiniteFocus and computed 3D simulation. InfiniteFocus provides reliable and calibrated data from the deposition of toner on a photoconductor. Based on these measurements simulations are computed and measured to increase speed and resolution of printing processes.

changes in both, the geometric as well as the electric set up. Also, the ability to trace the motion of single particles allows Océ to draw conclusions for further printer development. This makes it possible, for example, to understand why single particles are deposited in the background area, what influences the creation of sharp edges of small details or how to ensure a maximum optical density. The enhanced knowledge about these details allows Océ the optimisation of the geometric design of components, the electric and magnetic setup and various active control loops. This leads to a significant increase of stability of image quality, increase of printing speed and higher resolution.

Quality assurance with optical measurement in the paper making industry

InfiniteFocus is an optical 3D measurement device for surface analysis and true color visualization in 3D. Its operating principle combines the small depth of focus of an optical system with vertical scanning to provide 3D surface metrology from the variation of focus (Fig. 2).

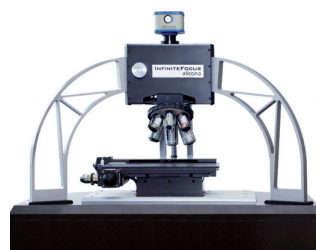


Fig. 2: InfiniteFocus – Optical 3D measurement device for quality assurance in paper and printer industry. Surface features such as roughness, profile, volume and area measurements are performed without deformation of the surface. InfiniteFocus is used for surface measurement and true color visualization for both, coated and uncoated paper.

InfiniteFocus is the only 3D measurement system that simultaneously captures the entire surface topographic information in combination with its true color information. 3D measurement is performed directly in the optical color image providing a visual correlation between the surface and its measurement. This feature makes surface measurement far more precise and flexible than with conventional tactile techniques. Surface data such as profile, area, volume and roughness are quickly and easily obtained. Measurements can be achieved in a vertical resolution up to 20 nm according to international ISO standards.

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The instrument can be used in both the laboratory and near production environment, it can also be operated by semi skilled technicians where required. Automation of functions can be added to make the instrument useable for the majority of surface metrology and inspection requirements.

In the paper industry the InfiniteFocus measurement tool greatly enhances quality assurance in many areas. The optimization of printing systems is only one field where the optical measurement system is in use. In paper making, accurate and robust surface control is of vital importance in the sector of coated as well as uncoated paper to enable a homogenous printing result. In terms of measuring and visualization InfiniteFocus provides dense and robust roughness measurement results according to EN ISO 4287. It provides data that no other techniques or system tools can provide in terms of surface homogeneity is concerned.

Another field where InfiniteFocus is used is for easy and traceable failure analysis of print images. Common phenomena such as the speckle effect (also known as snow effect), missing printing dots or aspects related to surface sizing can be traced back to its source which can be either poor paper quality or faulty printing processes. Compared to other, conventional surface analysis tools, such as tactile instruments, InfiniteFocus provides accurate non destructive measurements without deformation caused by tactile effects (Fig. 3).

Summary

Using reliable and calibrated measurements with simulations of toner characteristics on a photoconductor, a detailed insight about the physical background of the essential printing process steps in the field of electrophotographic printing systems can be achieved. The German manufacturer Océ printing systems used the optical 3D measurement device InfiniteFocus of Alicona Imaging to obtain accurate and verified 3D data of toner particles.

With the results from InfiniteFocus the verification of the print process with the simulation could be started. Ten 3x3 test patterns were printed, measured and averaged and compared with the average of ten simulated test patterns. The actual profile measurement of the deposited toner was very near to the simulated results with a difference of only 7.5%. This is in the same order of magnitude as the error bound of the measurement.

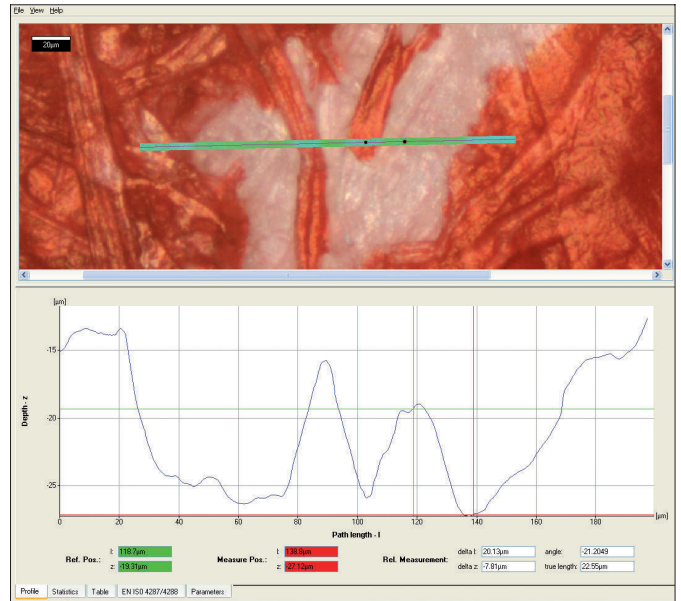


Fig. 3: Failure analysis with InfiniteFocus of a print image showing the speckle effect. To obtain 3D surface measurement results the user only has to place a profile line in the area to be measured on the optical image. This is easy as the true color image makes the blank spot clearly visible. The height difference shown here is too deep for an even color application.

With InfiniteFocus it was, for the first time, possible to measure the deposition characteristics of toner particles reliably and accurately within minutes.

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References

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