Revolutionary Xerographic Digital Production Press

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Abstract

The Xerox DocuColor iGen3 is a CMYK perfecting, sheet fed digital press that prints direct-to-media at up to 6000 impressions per hour (A4/letter). It is a fully integrated advanced production printing system with breakthroughs in imaging, marking, consumables, registration, color management, and paper handling. This paper describes the novel xerographic architecture and associated subsystem technologies that deliver benchmark image quality consistently. It provides an overview of the process by which each four-color impression is built on a photoreceptor belt and then transferred to the paper in a single pass. The controls for maintaining consistent registration and excellent, stable color fidelity will also be described.

Introduction

The printing industry has been experiencing technological changes in the past few years. Although this market has been traditionally dominated by offset printing, with the recent advances in digital printing technology, part of this offset printing will migrate to digital printing in the future. According to INTERQUEST, the growth of the total print volume will be slow, projected at only 7 % in the next two years. However, the digital printing revenues are expected to grow at a much higher rate, of 20% or more. In that, digital color revenues will experience the most growth, over 40%. The majority of the existing full process color volumes is in the commercial printing market segment. A one-percent share of the existing process color pages in the commercial print market equates to a 30% share of the same in the In plant/CRD market. The majority of full color applications in commercial print is for direct mail, books, and advertising and promotional literature. The average run length of all these applications has continued to decrease and is now close to 5000 impressions or less. The cost is becoming too high at this run length with traditional offset printing. Additionally, the digital production printer will be able to offer advantages over the traditional offset printing, of short run lengths with fast turn around and at a lower cost. The migration of short-run printing to digital printing will inevitably occur. One example is the book page trending toward digital and on-demand printing technology as the digital technology advances. It is predicted by Frank Romano to grow from 3% at 2000 to 48% at 2015. In addition, the unique advantages of digital technology will impact the color run length further as the DocuTech did to the black and white printing. The crossover of digital printing to traditional offset in terms of run length will continue to increase as the digital technology advances.

However, in addition to the run length, cost, and variable information (VI) provided by digital color printing, this technology also offers customers the print qualities equal to offset, the ability to print on many different substrates without curl, and an efficient workflow. Xerox DocuColor iGen3 press has the unique technologies that offer the customers a full efficient system of data entry, workflow control, and graphic art print quality.

DocuColor iGen3 Architecture & Design

DocuColor iGen3 architecture centers on SmartPress Imaging, SmartPress Paper Handling, and SmartPress Sentry. The output of this architecture are prints with color maintained within 3 delta E, from print-to-print, day-to-day, and machine-to-machine. This is achieved by a unique TRC control architecture and the implementation of other advanced control technologies. Color-to-color registration is maintained to less than 40 microns on the average. The uniformity in color and in quality across different media results from the unique Image on Image (IOI) process and its transfer technologies. It has a color gamut 25% greater than the standard four-color offset press. The halftone screens produce exceptionally smooth full sweeps with no color bands and no screen moiré. The Digital Front End (DFE) incorporates several advanced-image-rendering features, imposition, and VI capability.

Smartpress Imaging

This marking process is a single-pass dry ink non-impact marking subtractive four-color process with closed-loop controls and intelligent registration. The single pass marking technology is the center of the DocuColor iGen3 press. It differs from the classic 4–color Tandem engine by transferring the dry inks of "**all**" four colors to the paper **with a single step**. In the 4-color Tandem architecture, the transferring of all four color inks to the paper normally takes four to eight steps. Each color ink has to be transferred separately from an individual photoreceptor to the paper,

either directly, or through an intermediate transfer drum or belt, then to paper. This single step transfer greatly improves the DocuColor iGen3 image registration. The reliability of the printer is secured by the continuous monitoring, on-the-fly adjustments, same-edge registration, and straight paper path. The new dry ink formulations, concurrently with the marking process, achieve the wide gamut and the offset-like look and feel. The large developer canisters allow for a clean and easy process for dry ink replacement while the system is running to maintain productivity.

The DocuColor iGen3 single pass imaging architecture positions all of the four-color imaging and development stations around a 10-pitch flexible photoreceptor belt. Each imaging and development station consists of a high uniformity charging station, a high-resolution ROS imager and a state-of-the art non-contact development system. A full color image is produced on the belt by imaging and developing each-color ink, magenta, yellow, cyan, and black, sequentially onto the belt. All the four-color inks are then transferred to the paper within one single step. The toned image on the paper is then fused to produce the permanent prints. At the beginning of the imaging process, the surface of the photoreceptor is first charged to the required voltage within a uniformity of less than 5 volts. This is accomplished by the use of uniformed charging devices and a photoreceptor belt with highly uniformed photosensitive coatings. The latent image is then written onto the belt with ROS having an addressability of 4800 X 600. The dry ink is then developed onto the belt at the development station. The development station consists of a two-component developer sump, a magnetic brush, two donor rolls, and a set of development wires in contact with the donor rolls and adjacent to the photoreceptor. The dry ink particles are triboelectrically charged by their interaction with soft-magnetic carrier particles in the developer sump. A uniform layer of ink particles is then developed to the donor rolls by a magnetic brush. Near the photoreceptor, high AC electric fields between the wires and the donor rolls alternately attract and repel the charged ink particles, causing them to form a cloud in the vicinity of the wires. The ink particles from the cloud are then developed to the photoreceptor under the influence of the electric forces from the latent image. The toned photoreceptor then proceeds through the remaining three charging, imaging, and development steps as required to achieve the desired image / color. The non-contact nature of the development systems insures that previously developed images are not degraded, while also providing excellent line fidelity and solid density. Having completed the development of all four separations, the ink layers are transferred to the paper in one step at the transfer station. The transfer of the image from the photoreceptor to the paper is achieved by applying both electrical and mechanical forces. The electrostatic field created by the transfer charging devices is the primary driving force. The transfer of the ink layers is further assisted by the application of acoustic energy to the ink particles. Mechanical pressure is also applied between the paper and the imaged photoreceptor via a blade to ensure that the paper is in good contact. This unique combination of electrostatic, acoustic and mechanical forces applied simultaneously through the transfer step provides high image quality over a broad range of media from coated to uncoated, from textured to smooth, and from heavy to light weight. After the transfer, the toned paper is fused to permanently fix the image to the paper.

SmartPress Paper Handling

The paper stock attributes, such as size, grain direction, type, color, weight, coating, etc, are exported to the server for total system control of color/image processing, paper feeding, image-to-paper registration, transfer, fusing, decurling, and stacking. The straight paper path ensures high-reliability paper transport. The decurler involves a unique indentation roll in conjunction with a penetration shaft to automatically curl the fused paper down or up and exactly counter the curl established during the fusing process. The paper feeding technology employees Smart paper trays that enable automatic feeder and air system settings for altitude and each paper type considering size and weight. The trays consist of a new shuttle vacuum feeding system that is gentle on the substrate while having multi-feed detection and automatic tray tilt controls to adjust for curl in the stack. It also has auto tray switching and loading while running for maximum productivity. Learning algorithms are utilized to compensate for paper differences, component wear, and temperature fluctuation. The feed tray tilting mechanism utilizes a stack height arm/sensor and lead edge attitude sensor to ensure “on-the fly” adjustments. The paper registration system achieves side1/side2 and crossover accuracy by monitoring the same two paper edges during both the simplex and duplex (perfecting) steps. The architecture is designed especially for finishing. The electronic collation offers offset stacking. The top tray is designed for easy proofing. The wheel-out carts enable off-line and near-line finishing.

SmartPress Sentry Process

One essential element contributing to the excellent print quality from the iGen3 machine is the state-of-art image optimization technology. Our specifications for color registration is within 85 microns for any color to any other color, anywhere on the page, on any system. This is less than half of one row of halftone dots at 150 line per inch. The average color registration is within 40 microns. The accuracy of this level of registration is accomplished by the closed looped precision control on the ROS, photoreceptor belt motion, and the color registration on the belt. The lateral margin, lateral magnification, and image timing of the ROS are tightly controlled. The scan-line, image bow, and image skew are automatically corrected. The belt edge sensor, coupling with the learning algorithm, ensures the proper control of the belt steering. The remote encoding and 8^{th} order-triple-integral motion control guide the belt motion. The belt module is designed to have the roll sizes directly matching the image pitch in order to synchronize

the roll rotation and the belt motion. The belt registration is accurately monitored with a closed loop sensor. In addition, the TRC, development, environmental, image timing, and copy-to-copy registration, smart paper tray, sheet registration, paper adaptive fusing, page adaptive active decurling, and stacking are close looped-controlled to provide the customer with prints of consistent, predictable, and accurate color. All these controlled functions are monitored with the DocuColor iGen3 customer's choices of color server and controller from Xerox DocuSP or Creo Spire. The Xerox DocuSp Controller offers easy color on demand, DocuTech production workflow, and variable content with VIPP. The Creo Spire color server offers world-leading color management, the same familiar interface used on DocuColor 2060, with VPS and VIPP for variable data. These two controllers provide the brain for control and monitoring all the printing processes, and the customized printing process, easy proofing, and variable data manipulation.

Conclusion

The DocuColor iGen3 architecture utilizes the concepts of SmartPress imaging, SmartPress Paper Handling and SmartPress Sentry. With the combination of these technologies, DocuColor iGen3 press provides the customer with unequalled print quality, reliability, flexibility and economics. The customer gets more saleable page-per-shift than any other digital color sheet-fed production press. This printer produces up to one hundred 8 ½ x 11" or A4 impressions per minute. You can load and unload paper and replenish dry ink while running. With the state-of-art image-on-image marking technology and extensive controls, the output meets the quality required for the graphic arts industry consistently sheet-to-sheet and job-to-job.

Biography

Paul Garsin holds a Bachelors degree in Chemical Engineering from Clarkson University and Masters degree in Chemical Engineering from the University of Rochester and in Electrical Engineering from Rochester Institute of Technology. He has worked for Xerox since 1972 in advanced engineering and product development specializing in marking system technologies and system image quality. Paul is presently the Image Quality Manager of iGen3.