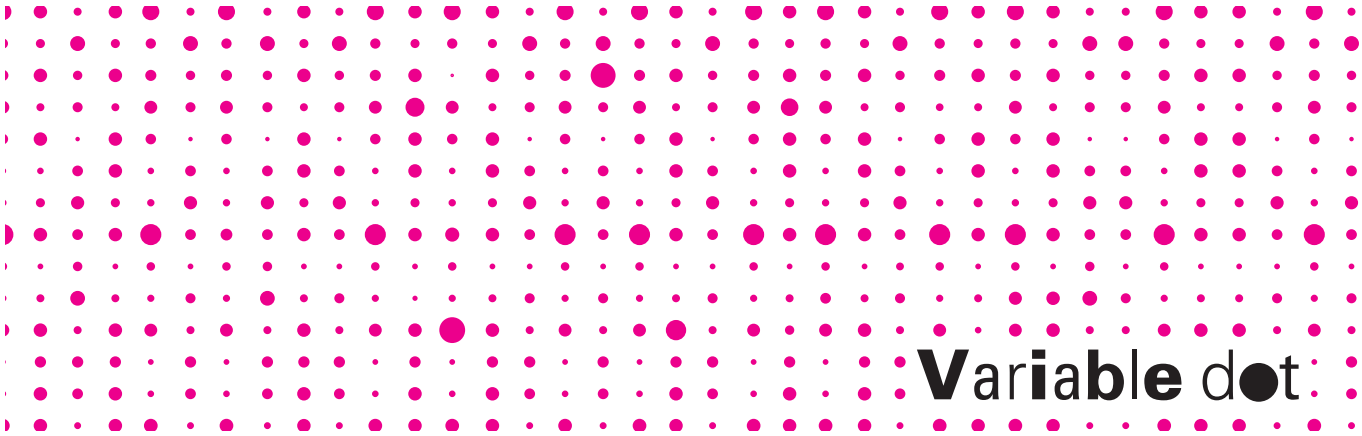
Variable-Dot Printing: Why Dots-Per-Inch is No Longer the Only Measure of Inkjet Print Quality



Already, the industry has seen significant advances in quality from new printing technologies that use variable-drop technology. Early adopters of these devices no longer distinguish between "inkjet" or "photo-quality" prints as the variable-dot technology produces comparable results.

The large-format digital printing industry — now commonly known as display graphics — has always relied on the spatial resolution measured in dots-per-inch (dpi) as the standard for print quality. The more dots in a 2.54-cm (1-inch) space, the greater the quality.

The correlation of higher quality to higher dpi is certainly defensible, assuming one thing: The dots are all the same size. Recent developments in inkjet technology have turned this standard on its side. New generations of printers using variable-dot printing have proven that dpi isn't the end-all when it comes to judging print quality.

Six-Color Printing: First Steps to Better Inkjet Quality

In the early days of display graphic, wide-format printing, it was discovered that CMYK inks for print areas that required ink coverage in the quartertones (15 percent-to-35-percent area coverage) was problematic, and resulted in a grainy printed image. This was considered unacceptable because the most predominant use of quartertones in printing is in the reproduction of skin tones.

The excessive graininess was caused by the limited ink coverage (by area) in the quartertones because only one to three pixels of every 10 contained ink; a lot of white space remained in the image. The idea of adding lighter inks, which could be printed more liberally over the media in the quartertones, was introduced in the mid-1990s.

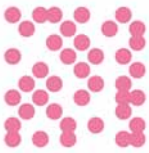
These six-color printers allowed for ink coverage of at least twice the area, thereby greatly reducing the grainy appearance of skin tones and other quartertone image areas. The downside of this solution was it used more ink than the four-color systems in order to provide greater ink coverage for smoother skin tones. But the trade-off was acceptable; at the time, the additional ink cost could be built easily into the end-user pricing.

Variable-Dot Printing Delivers Superior Quality

While the six-color printing technique has become more accepted among manufacturers, printers and their clients, variable-dot printing has emerged, rendering six-color printing obsolete. With variable-dot printing technology, piezoelectric print heads can produce droplets of varying volume on demand. This enables the RIP software to specify the appropriate droplet size for each specific image feature. When imaging fine detail such as small type or fine lines, very small droplets can be used. When imaging areas of tonal transition or quartertone values, such as skin tones, drops of medium volume can

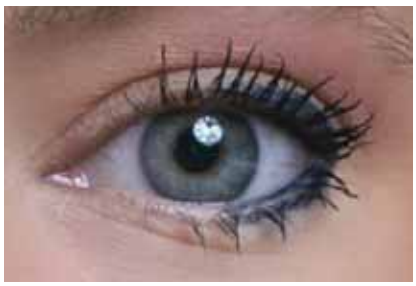
by Jeff Edwards, International Product Marketing Manager, Océ Display Graphics Systems

Various Techniques of Quartertone Printing (most often found in skin tones)

Grainy	Better	Best
		
4-color printer	6-color printer	4-color printer with variable dot
Few, large magenta droplets: 20-percent magenta as printed on a four-color fixed droplet printer using only magenta ink	More, large light magenta droplets: 20-percent magenta as printed on a six-color fixed-droplet printer using only light magenta ink	Many, small, variable magenta droplets: 20-percent magenta as printed on a four-color variable droplet using only magenta ink

Compare the same image:

Fixed-dot printing



Variable dot printing

be used. When printing high-density areas such as solid colors, you can use large droplets.

The dot size and ink quantity per dot vary by manufacturer. For example, the Océ Arizona® 250 GT UV-curable printer uses Océ VariaDot™ technology, which can produce seven levels of gray with dot sizes varying from 6 to 42 Pico liters. Printers from Mutoh® use Dynamic Variable Dot Imaging technology in two modes: Each produces three levels of gray, one from 7 to 21 Pico liters and the other from 3.5 to 12.5 Pico liters. Printers from Mimaki and Roland also use three sizes of droplets. The ability of these printers and others to vary the dot size for every pixel enables them to fine-tune the amount of ink at any location, based on the image area being printed.

The result of variable-dot printing is near-photographic image quality. For printers with a wider range of variable drop sizes, the image quality will reveal a sharpness that only previously has been seen at resolutions of 1,440 dpi or higher.

The quality of images printed using variable-dot technology can exceed the quality of those printed on current six-color printers using outmoded, fixed-droplet-sized print head technology. A noticeable difference also can be seen in type; smaller dot sizes can result in perfectly legible text as small as 6 points.

Quality Consistency, Cost Savings

Quality consistency is an added benefit of variable-dot printing. Compare it with painting a room in a house. A large brush size is used for quick coverage over large areas and a much smaller, finer brush is used for detailed areas. Trying to paint a large wall with a tiny brush would result in many artifacts, while trying to paint a fine fresco trim with a large brush would be frustrating. In the same way, variable-dot printing uses the appropriate size droplet for each specific image feature, resulting in the best possible image quality in every part of the printed image.

In addition to superior image quality, variable-dot imaging technology with four-color inks uses less ink compared with six-color printers with fixed-droplet inkjet technology. Depending on the print head, the lower ink consumption can result in ink savings of 30 to 50 percent over fixed-droplet, six-color printers.

Tests conducted by Océ have shown four-color printing with variable-drop print heads results in an ink consumption rate that is significantly lower than that of comparable six-color printers using fixed-droplet inkjet technology.

On average, 30 to 35 percent less ink is consumed in the printing process because less ink is required when the printing values of cyan and magenta are below 50 percent. This is the values range where light cyan and light magenta are extensively used on six-color systems. On printing systems that do not employ extensive ink purging routines for pre-print, inter-print or post-print maintenance, the overall reduction in ink consumption can be as much as 50 percent.

A New Measure for Image Quality

While the measurement device has changed, it's all for the better for commercial shops and for users. It may take some time for the industry to embrace this new quality standard. Some equipment vendors, trade publications and analysts still favor dpi and six-color printing as the main image quality factors because they are easier to use in an at-a-glance comparison. The standards, like the industry, are evolving.

Already, the industry has seen significant advances in quality from new printing technologies that use variable-drop technology. Early adopters of these devices no longer distinguish between "inkjet" or "photo-quality" prints as the variable-dot technology produces comparable results. If you look beyond the dpi standard when judging quality, you will see how variable-dot technology delivers exceptional results without being tied to a number.

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