If I scan, you scan

Drums, desktops, flatbeds and handhelds. Gordon Laing explains the different types of scanner and how to achieve the best possible printed results from your efforts.

Okay okay, I know. The Paintshop Pro 4 review I promised you'd find in "First Impressions" last month is in fact published this month and it's written not by me, but Paul Begg. It's all to do with the pressures of becoming *PCW*'s Features Editor! And another apology for the lack of a Font of the Month last issue (and indeed, this time) — time and space ran out on me. I assure you it won't happen again… at least not for the next few months! One consolation for graphics and DTP fans are our extensive reviews of Adobe Photoshop 4 and PageMaker 6.5 elsewhere in this issue [page 180].

Last month, I dipped into the enormous subject of printing your graphics and desktop publishing files and skimmed the surface of preparing for output on commercial printing presses. The gist of what I covered is that a lot of the time you'll want fabulous quality and full colour output which your own personal printer is simply incapable of producing. The answer is to send your files to someone who has a suitable printer and have them do it for you.

There are downsides, of course. You'll know your work back to front but to the printer, it's just another job. Consequently, you'll have to make sure the printer knows precisely what elements are involved, such as fonts, images and even the specific colours used. It will often be your responsibility to ensure that the files are in the correct format and are compatible with the applications used by the printers.

You should also figure out your expectations of quality, preferably before starting work. Just how good do you want it to look? Is the job to be output on special materials or in large volume? Most important of all, how much do you want to spend? Discuss your requirements with several printers and bureaux before making your final decision, and bear in mind that it may be considerably more expensive than you'd first imagined. Remember these bureaux have to cover the (often enormous) investment they have made in high-resolution drum scanners, film imagesetters and high-speed printing presses.

We scanned a printed letter g, measuring only 5mm tall, using a Umax PowerLook flatbed. Left was scanned at the highest optical resolution of 600dpi, while far left was scanned at the highest interpolated resolution of 4,800dpi. Notice how interpolation in this case has created a much smoother result. But not all scanners are this good at interpolation

Skimping and scanning

It's not all doom and gloom, though. There's nothing more exciting than seeing your hard work jump off the screen and onto the printed page. There are plenty of ways you can save money here and there, particularly in the area of image scanning.

Last month, I implied that many people could save a fortune by using their own desktop scanners rather than relying entirely on expensive bureau drum scans. The important word here is "entirely". Unless you're on an extremely tight budget or are satisfied with less than excellent quality, you'll still have to make some drum scans.

A drum scanner is an extremely high-quality device which, typically, can capture finer details and shades than even a top-of-the-range desktop scanner. Drum scanners come into their own when working with transparencies, which are often small, requiring high resolutions, and frequently feature subtle transitions of colours. These nuances are frequently lost on lesser devices. Again, it depends on your expectations and the size at which you wish to reproduce images, but when outputting an image at A4, particularly if it's for the cover of a magazine, or for a poster, it's worth using a drum scanner.

But what about reproducing smaller images, or working on a less exacting job? This is where the often-neglected desktop scanner can really come into its own and begin to save you lots of money. Before launching yourself headfirst into a total DIY job and wondering why it doesn't always come out as planned, please remember why there are thousands of professional scanner operators, designers and artists employed throughout the world. At the same time, it's great fun and extremely fulfilling to complete a job single-handedly, no matter how it turns out, so here goes with the tips.

Resolutionary talk

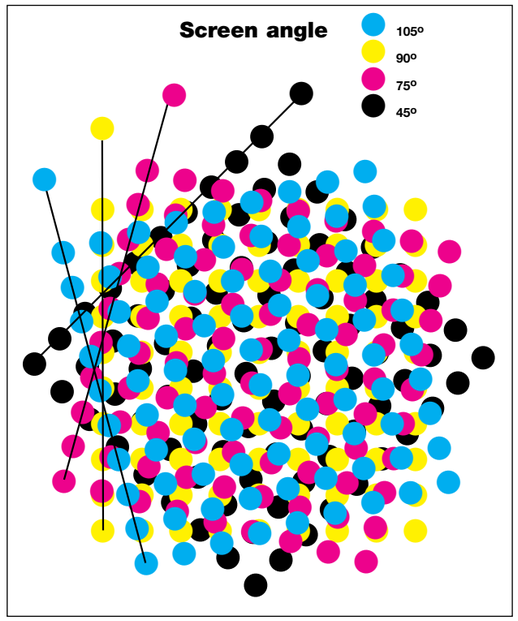
Probably the most misunderstood of all scanner terms is resolution. Advertisers hardly help matters when they start quoting unrealistically high, or often irrelevant, interpolated resolutions. So here's the truth: a scanner's true resolution is its optical resolution, typically either 300, 400 or 600dpi for a flatbed device. Interpolation is the process of taking two adjacent dots, calculating the average between them and sticking another in-between. Effectively, you've doubled the resolution.

It doesn't just stop at doubling, however. Many advertisers talk of interpolated resolutions of 4,800dpi, which looks impressive in an advert. In practice, this means that for every true dot, the scanner is inventing between eight and 16 of its own. Interpolation works better on some occasions than others. The really good systems will consider several real dots and calculate the trend before creating any new ones. The general rule, however, is to take interpolated resolutions with a pinch of salt and only really use them when scanning extremely small or detailed objects, particularly in black and white line art.

Another confusion creeps in with printers. Many people own 300dpi or 600dpi printers and believe quite reasonably that they should therefore go for a 300 or 600dpi scanner, but this only holds true in a minority of cases. One universal scanning truth, regardless of whether you're working with colour, greyscale or black-and-white images, is the larger you want to reproduce them, the higher the resolution you'll need to scan them. Bear this in mind when you're working with tiny originals such as 35mm film, stamps or coins.

Pure black-and-white (not greyscale) images, known as line art, require high scanning resolutions but often work well with interpolation. If you have an A5 original image and want to reproduce it at the same size on a 300dpi laser printer, you should scan it at 300dpi. Easy. If you want to reproduce it at twice the normal size on the same printer, you'll need twice as many dots, so you should be scanning at 600dpi. Similarly, if you want to reproduce it at half size, then you need only scan at 150dpi. If your original is only an inch high and you want it to fill an A4 page of a 300dpi printer, you'll need to enlarge it eight times and scan it at 2,400dpi.

This rule applies to colour and greyscale images but only if printing on a continuous-tone printer, such as one using dye sublimation technology. Unfortunately, these are few and far between, and very expensive. The vast majority of printing takes place on devices which are incapable of printing shades. Remarkable as it may seem, the standard laser printer (and even high-resolution image setters) are incapable of printing anything other than a solid dot, or no dot at all.



In CMYK colour printing, each ink must be placed at a different angle to prevent the halftone dots clashing (look at magazine photos)

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Shades on

Shades are achieved by varying the size and density of dots. Just look closely at newspaper photos or at posters to see that greyscale and colour photos are in fact made up from groups of dots. At a distance, large dots close together are perceived as dark areas, while small dots spaced far apart are light.

The process of converting a continuous-tone photographic image to a group of dots is known as halftoning, and the variable-size dots themselves as halftone dots. Halftoning in greyscale and colour was explained in greater detail last month. The important note this month is that the scanning rules differ.

The screen resolution, or ruling, slightly confuses the matter. This refers to the number of halftone dots per inch, but is usually measured in lines per inch (lpi). Newspaper photos are quite coarse and printed on poor-quality paper at around 75lpi. Decent glossy magazines, such as *PCW*, are printed at 133lpi, while the highest quality art reproductions on the best paper may be printed at 150lpi.

The important thing to remember is that the screen resolution refers to the number of halftone dots per inch, and that these dots vary in size to simulate shades. Unfortunately, most printers are also only able to print one size of dot and thus end up grouping several to make a single halftone dot. These groups are usually a grid of printer dots, say four by four, offering 16 differently-sized halftone dots, resulting in 16 shades of grey. For a screen resolution of 75lpi, you'll need to print 75 of these grids per inch. Since each grid measures four printer dots wide, you'll need a printer resolution of (4 x 75) 300dpi.

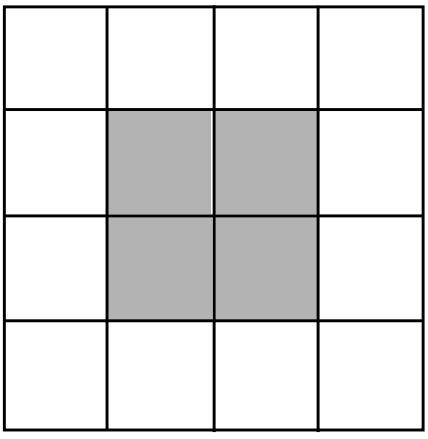
That's why a laser printer isn't great at reproducing shades or photographs. While its resolution is sufficient for solid black text, 300dpi just doesn't cut the mustard for halftoning. In order to reproduce the 256 shades of grey required in this magazine, we need 16 x 16 grids of printer dots which, at 133lpi, means we would need an image setter with a resolution of over 2,000dpi!

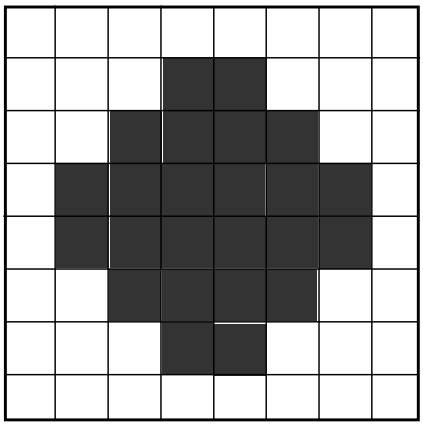
Doing the scan-can

But what about scanning? The general rule for colour and greyscale images, which are to be halftoned by the printer, is to scan at double the screen resolution. If your screen is 133lpi, then somewhere between 250 and 300dpi scanning resolution would be sufficient. If you're printing at 75lpi, then scanning at 150dpi is fine.

This rule applies to same-size reproduction. But if you want to print at twice the original size, you'll need to double the scanning resolution. Printing at half the size means that you can scan at only half the resolution.

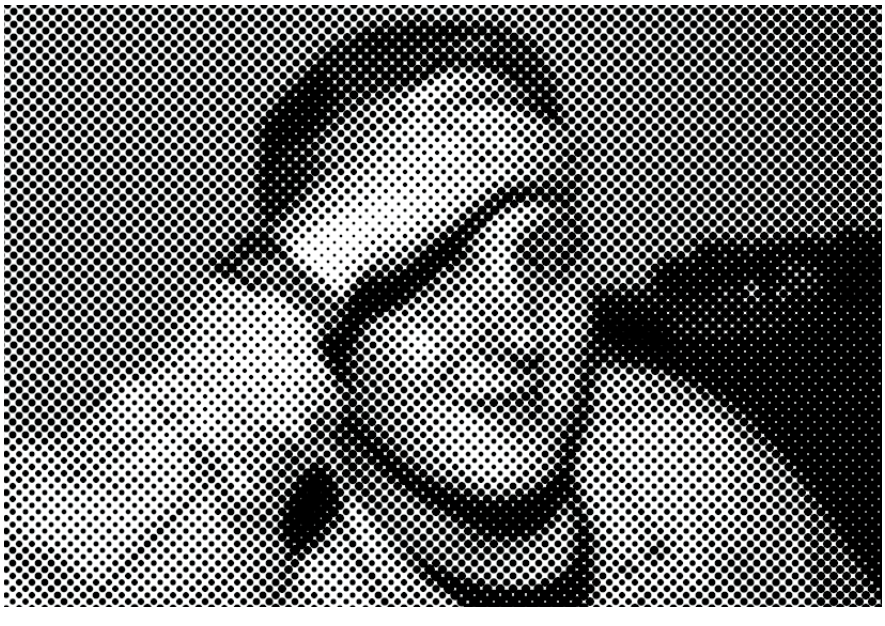
Take an A4 photograph which is to be printed at a quarter of its size in *PCW*. At the same size, we would need to scan at around 300dpi, but at quarter size 75dpi would be sufficient. A 600dpi laser printer is capable of printing an eight by eight grid, offering 64 shades of grey at a screen resolution of 75lpi. The same A4 photograph should be scanned at no more than 150dpi for reproduction at the same size on this printer.





Top A halftone dot made from a 4 x 4 grid can produce 16 combinations, simulating 16 shades. Above An 8 x 8 grid can simulate 64 shades

To reproduce tiny originals at a decent size would require very high resolutions, but for average-sized originals most flatbed scanners are up to producing quite a professional job. But this is only as far as resolution is concerned. Colour capabilities vary enormously between scanners, and between different printers and monitors. A colour you have scanned is rarely the same one that you see on-screen and even less likely to be the same one you see printed. Worse still are colours that happily exist on your screen but which simply cannot be reproduced on the printed page by conventional means. In two months' time I'll talk about how to overcome this seemingly insurmountable problem.



Squint and see how halftoning can simulate shades by using different-sized black dots

PCW Contacts

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