Apple LaserWriters: Screen Frequency and Gray Levels (9/95)

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TOPIC ---

This article discusses customizing printer halftones, screen frequency, and gray levels for optimum output.

DISCUSSION ---

Determining the optimal relationship between gray levels and screen frequency is quite simple once you understand a few basic concepts of laser printers. Like computers, laser printers understand only two values: on and off (black and white). They simulate grays by varying the amount of dots within a certain area, called a halftone grid. Halftones are made of grids, just like the paper used to graph functions in trigonometry. To create a halftone, laser printers place dots within each cell on the grid. The screen frequency (which is a misnomer these days, but we still use the term leading when talking about the space between lines of text) determines the size of each cell in the grid.

Most laser printers can produce only a given size dot, however Photograde is the exception. Because the dot size is fixed and increasing the line frequency decreases the size of each cell, the gray levels which can be produced are inversely proportional to the line frequency. Visualize a grid and keep in mind only so many dots can be placed on a region of paper. In a 600 dpi printer, such as a LaserWriter Select 360, the dpi does not vary, but you can vary the size of the grid. Because printers produce grays by varying the amount of dots within each halftone cell, making the cells smaller will allow fewer grays in your halftone. The following formula lets you easily determine how many grays you can get for a given resolution and screen frequency with an angle of 0 degrees.

(Output Resolution / Screen Frequency)^2 + 1 = Gray Levels

For example, consider the LaserWriter Select 360.

(600 dots per inch / 100 lines per inch)^2 + 1 = 61 Gray Levels

With a little juggling, you can also use this formula to determine what screen frequency yields a desired level of grays. For a bit easier calculation, simply divide the dots per inch by the square root of the grays levels to determine the screen frequency:

Dots Per Inch times / sqrt(Gray Levels) = Screen Frequency

Staying with the Select 360 example, if you want 100 gray levels:

600 / sqrt(100) = 60

Again, you can rearrange this formula to calculate different variables. Keep in mind Postscript is limited to 256 shades of gray, so your largest divisor in the preceding formula will be 16. Even for high-end work though, Postscript does an excellent job. Plug a 150 line screen into the formula and you will see you need a 2,400 dpi printer to produce 256 grays.

The discussion above holds true for fixed resolution printers, but Photograde changes the rules by varying the timing of the laser pulses to vary the size of the dots within each cell. The LaserWriter Pro 600/630, Select 300 and IIf/IIg use Photograde technology. Photograde is capable of producing 91 levels of grays using a 106 line screen at 300 dpi. This is sufficient for proofing photographs and low-quality newsletter output.

Also keep in mind 300 dpi and 600 dpi laser printers cannot replace imagesetters or traditional darkroom halftones. Some 1,200 dpi laser printers can produce acceptable halftones for reproducing on newsprint, but users will have to experiment with dot shape and line angle to determine what works best with their particular printer and press. The best solution is to output final copy directly to film on an imagesetter and use laser printers for proofing.

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