

Appendix B:

Notes on Scaling, Rotating and Dots Per Inch

Scaling

Scaling is performed simply by using the Scale panel in either the Preferences or the Image Inspector. The Preferences panel affects new images opened and images being converted, whereas the Image Inspector affects images already open.

paste_35.tiff ↵

A number of different units may be selected through the Units pop-up list:

paste_36.tiff ↵

Example: A user wants to make his picture twice as wide and half as high as the original. Simply select Percentage in the Units pop-up list and type in 200 in the Width field and 50 in the Height field. The Proportional switch should not be checked (more on this later).

paste_0.tiff ↵
Original Image

paste_1.tiff ↵
Final Image

Example: A user wants to make his picture 1 inch wide and 2 inches high. Select Inches in the Units pop-up list and type 1 in the Width field and 2 in the Height field. Again, the Proportional switch should not be checked.

paste_0_1.tiff ↵
Original Image

paste_2.tiff ↵
Final Image

Note: NeXT monitors claim to be 72 dpi when, in fact, they are not. Be assured that if you print out a $1^\circ \times 2^\circ$ picture, it will be the correct size.

When the Proportional switch is pressed, Pixel Magician will attempt to make the final image proportional to the original and no larger than the dimensions given. This is especially useful for automatic enlargements when opening/ converting pictures.

Example: A user wants to make all pictures as large as possible while keeping the proportions of the original image. Assuming $1/2^\circ$ margins, select 7.5° for the width, 10° for the height, and be sure the Proportional switch is checked. If starting with a square picture, the result would be a $7.5^\circ \times 7.5^\circ$ image.

In the Image Inspector, Pixel Magician will dynamically adjust the height or width to keep the dimensions proportional as the user is typing.

Hint: This automatic update behavior may fill a field with more digits than are shown on the screen. We believe the extra precision is useful to give the user fine control over the scaling of his images, but occasionally this feature can be a nuisance. When entering a fresh value into the Width or Height field, it is a good idea to double click on the old field value, thereby

selecting it. When the new value is entered, the old value is completely removed, including any extra digits of precision not seen on the screen.

Rotating

Rotating is accomplished simply by moving the slider in the Rotate panel or by typing into the input field. A maximum of five significant digits are provided to give the user fine control over the degree of rotation. This is especially important since PostScript does not anti-alias rotations.

Hint: Less fine control is possible for large rotations than for small ones because of the five significant digit limit. However, checking both the Flip X and Flip Y switches is equivalent to an additional rotation of $\pm 180^\circ$. Thus, a user who wanted to rotate by exactly 175.5555° could check Flip X and Flip Y and rotate instead by -4.4445° .

When the Proportional switch in the Scale panel is checked, non-uniform scaling is performed on the resulting image in an attempt to make the final dimensions of the picture proportional to the original image. For non-square images, this will skew the angle of the picture because, in general, *there is no way to uniformly scale a rotated picture so that its dimensions will be proportional to the original.*

Example:

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paste_37.tiff ↵  
Original Image
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paste_3.tiff ↵
Image Rotated 45° with Proportional unchecked

paste_4.tiff ↵
Image Rotated 45° with Proportional checked

As can be seen above, there is no way to make the final image proportional to the original without distorting the angles.

If preserving the angles is more important to you than making the final image proportional to the original, do not check Proportional when you apply the transformation. If Proportional is checked, the entries in the Scale panel refer to the *final* dimensions of the image and the angles may be skewed. If Proportional is not checked, the entries in the Scale panel refer to the dimensions of the image *before rotation*, and angles will not be skewed.

Dots Per Inch

Dots per inch (DPI) is one of the harder concepts for many users to grasp, in part because the screen has a fixed resolution. The DPI fields determine how much data is actually present per inch. Since the screen is fixed at 72 dpi (and the NeXT printer at 400 dpi), to make the image on the screen

approximate the real image, the image must be resampled. PostScript resamples images by replicating rows or columns of pixels to make a picture appear larger and eliminating rows or columns to make a picture appear smaller.

Example: The user has a 144 dpi image and displays it on the screen. This means that there are two pixels of data for every pixel on the screen, horizontally and vertically. PostScript will show only every other pixel going across and every other pixel going down the image. Three-fourths of the pixels are not shown—technically, they are *eliminated*.

Example: The user has a 36 dpi image and displays it on the screen. This means that there are two pixels on the screen for every pixel of data, horizontally and vertically. PostScript will duplicate each pixel horizontally and vertically so that the final picture will be the correct size.

Because resampling can be an expensive operation, Pixel Magician attempts to delay resampling in certain situations. Resampling can be forced by saving the picture and opening the result.

Example: A user sets the DPI fields to 72 but keeps the size of the image the same. The image should now look much blockier since each pixel of data is now 10 times wider and higher, but the image looks the same since Pixel Magician has not yet resampled the image. To force resampling, save the image and load the result.

paste_7.tiff ↵

Original Image at 72 dpi

paste_8.tiff ↵

Resampled Image at 72 dpi

When increasing the resolution of the image, often no change will be seen

on the screen. This is because (1) the resulting image really has no more data than the original by Shannon's law, data cannot be created out of thin air (it can only disappear into thin air), and (2) the screen, being a fixed resolution device, is incapable of accurately showing images which have more than 72 dots per inch of resolution. In this case, printing the image may show detail which the screen cannot.

If the horizontal and vertical resolution are different, the Proportional switch may give unexpected results. This is a known bug. Again, this can often be avoided simply by unchecking Proportional before hitting the Apply button.

The concept of horizontal and vertical dots per inch is not, in general, well-defined when the image is rotated. Using different horizontal and vertical resolutions while rotating can often produce unexpected results. We recommend that if you want to produce a rotated picture with non-square pixels, follow a multi-step procedure, performing a few transformations in each step.

Example: A user wants to rotate a 72 dpi \times 18.4 dpi picture by 45° and save the result as a 36 dpi \times 72 dpi image.

1. Resample image to 72 dpi \times 72 dpi while keeping the size constant, save (to force resampling) and reload.

paste_9.tiff ↵ paste_10.tiff ↵
Original Image at 72 dpi \times 18.4 dpi Image Resampled to 72 dpi \times 72 dpi

2. This image looks almost the same as the original (it has a small aliasing error), but it has many more pixels and takes up more space on disk and in memory. Now rotate this picture, save it and reload it.

παστε_11.tif ←
72 dpi Image Rotated 45°

3. Finally, change the dpi again while keeping the size constant, save it and reload it a final time. Making the intermediate picture finer than 72 dpi may yield even better results.

paste_12.tif ↵
36 dpi × 72 dpi Final Result

By applying transformations one at a time, the user has a great deal of control over the final result.

Some users are confused about how the DPI fields affect the Width and Height fields in the Scale panel. Basically, the two fields are independent. When the Units pop-up list is set to Inches and the DPI fields are adjusted, the image is resampled to the new resolution; but the size of the image in terms of inches remains the same. Centimeters, Points and Picas in the pop-up list behave the same way. When Pixels is chosen and the DPI fields are adjusted, the image is resampled to the new resolution; but the amount of data in terms of pixels remains the same. This means that the picture will change in size since each pixel now has a new size. Percentages work in the same way as Pixels, *mutatis mutandis*.