

A Basic Summary of Image Formats

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Abstract. We summarize here the most used image formats, and their respective principal applications.

Keywords: image formats, raster type, vector type.

1 Introduction – Why Using Different Image Formats

Simply by navigating on the Internet, you see how many image formats are available to you: BMP, GIF, JPEG, PNG, RAW, SVG, TIFF, ... You can directly store an image of this kind on your hard disk, without thinking about the size it could take, or the further use(s) of this image. A recurrent problem is that people do confound these formats, and their specific properties, resulting in inappropriate image encoding choices, and aberrant behaviour.

These choices have (sometimes important) consequences for further uses of these images, and we here want to summarize the most important formats and the raster – vector classification to avoid this kind of naive reactions.

1.1 Classification

We can categorize image formats in two categories: *raster* and *vector*.

Raster Images These formats store images as *bitmaps* (also called “pixmaps”). Briefly, a *raster*

graphics image or bitmap is a data structure representing a generally rectangular grid of pixels, or points of color. The main problem of the raster image format is that the graphics are *resolution-dependent*.

Because of this, a raster image *cannot* be scaled to a higher resolution (than the original one) without a given loss of quality. Depending on the desired image resolution, a loss of apparent quality is often observed.

Some kinds of raster images are BMP, GIF, JPEG, PNG, RAW, TIFF. We give a description of these ones in Table 1.

Vector Images These formats store images as *vectors*. We know that a vector is defined by three main properties: a direction, a magnitude, and a sense.

Thus, vector image formats contain a geometric description which can be rendered smoothly at any desired display size, although these files do not have a big size.

Vector file formats can contain bitmap data as well.

Some kinds of vector images are CGM, EPS, SVG. We give a description of these ones in Table 2.

| Extension | Acronym | Description | Advantages | Disadvantages |
|-------------|----------------------------------|---|---|--|
| BMP | Windows BitMap | Handles graphics files within the Microsoft OS. | Wide acceptance, and use in Windows programs. | BMP files are large (uncompressed). |
| GIF | Graphics Interchange Format | Supports 256 colors; Color-depending ¹ ; Widely used to provide image animation effects. | Supports animation. | Limited to 256 colors; No real role compared to other formats. |
| JPEG | Joint Photographic Experts Group | Supports 8 bits by color, for a 24-bit total; Habitually lossy. | Small files; Compression does not ² noticeably detract from the image's quality. | |
| PNG | Portable Network Graphics | Supports truecolor (16 million colors); Best suited for editing pictures; Lossless. | Excels when the image has large, uniformly colored areas; Robust. | Many older browsers currently do not support the PNG file format. |
| RAW | N.A. | Family of raw image formats; Available on some digital cameras. | | Not ³ standardized/document; Differ among camera manufacturers. |
| TIFF | Tagged Image File Format | Normally saves 8 or 16 bits per color; Lossy; Lossless. | Widely accepted as a photograph file standard. | Not well supported by web browsers. |

Table 1. Comparison of the main image raster formats.

| Extension | Acronym | Description | Advantages | Disadvantages |
|------------|----------------------------|---|---|---------------------------------|
| CGM | Computer Graphics Metafile | 2D vector graphics, raster graphics, text. | | Superseded by DXF, SVG formats. |
| EPS | Encapsulated PostScript | Used for compatibility with PS documents. | Interesting for good-looking documents. | |
| SVG | Scalable Vector Graphics | Open standard; Versatile; Scriptable; All-purpose for the web and otherwise; Key component in web applications: interactive web pages; Lossy; Lossless. | No compression scheme of its own, but thanks to XML, an SVG graphic can be compressed using a program such as gzip . | |

Table 2. Comparison of the main image vector formats.

Notice that lossless and lossy characteristics were not respectively put in “Advantages” and “Disadvantages” categories, because being lossy can be an advantage, and being lossless can be a drawback.

1.2 The Uses

The best way to know which format file you have to choose for your images is to think about their *further* use. Here are some basic rules.

1. If these images need to be retouched, and modified, it is always better to keep them in their original resolution, until they are published;
2. When raster images are published, save them with an adapted resolution: e.g. if they only need to be reused as a button, do not save them at a high resolution, and reciprocally;
3. For picture distribution, choose JPG files, which are generally smaller than PNG ones;
4. If you work with colored images which have large and uniformly colored areas, choose the PNG format (if possible);
5. If you work with vector images, never save them as raster images;
6. Ideally, all diagrams, graphics and shapes should only be saved in vector format.

Concerning the point 3, another advantage of this technique is that, as JPG images are of less quality than the PNG original files, they cannot be scaled to a higher resolution without making imperfections visible. By this way, people cannot for example make posters of the pictures you worked on if you do not want them to.

The GIF format is still used, because suitable for storing graphics with relatively few colors such as cartoon style images. It is also useful for simple diagrams, logos and shapes, but it is here prefered to use vector format.

All the given points are often respected, except the 1, 5, and 6 ones. An effort must be done to avoid this kind of situations.

2 Why People Have to Be Aware of the Different Image Formats

As discussed previously, the way an image is redistributed has a big influence on it. For a picture, if it is too highly compressed, it can have no interest,

and, for a plain web button, there is no interest in using a high resolution, but an interest to use a vector format. Furthermore, if graphics are saved as raster images, and if they need to be put in a good-looking document, they must be re-plotted. It is essentially tedious when graphics are complex. It is not the case if the graphics are in a vector format.

2.1 In a Document

Let’s take a sad (but real) example. Your research field is Physics, and you have just drawn a vectors situation. You have evidently drawn this situation using a program like Xfig, and saved it as EPS, for example. You now put it in your document. The output is given at Figure 1. One of your colleague has to draw the same situation, but does not know the difference between raster and vector formats, and chooses a small resolution, because he wants the image not to have a big size on his HDD. He then puts it in his document. The output is given at the second figure.

The difference between the two given figures is clear. On the second one, you could imagine that the original image was Figure 1 and that it was scanned “in chain.” In fact, no: Figure 1 has simply been converted to JPG format, with a high compression, and a lower resolution. On Figure 1, do not hesitate to zoom as deeper as you want: you will never see pixelization effects. It is due to the nature of the EPS format, and, more globally, to the vector format, as explained before (see point 1.1). Anyway, a lot of scientists still save such vectors drawn as JPG, or in other lossy formats. Sometimes, images are saved in EPS format, and then saved as JPG format, to include the JPG format in the final document!

2.2 On the Internet

When surfing on the Internet, we encounter too often heavy pages, albeit these pages do only have a small amount of tiny images. Then, by loading the images independently, we notice that the webmaster has simply reduced the displaying size of the image by modifying HTML `img` properties (attributes `height` and `width`), and that the linked image file has a size of 1 or 2 Mo.

Anyway, this problem is solved in a simple way: using size-adapted miniatures for this kind of web pages, and original images if needed, e.g. available when clicking on the miniatures.

If this principle was respected on every website, the web-surfing could be more profitable to everybody, for evident reasons.

3 Which Vector Programs You Need to Use

3.1 Raster images

Raster images must not be “boycotted:” they have significant advantages that must be taken into account, but for specific uses (which were given at 1.2), and never for scientific *croquis*.

Numerous programs have been created for creating and editing raster images. Among them, we can cite “The GIMP” (see <http://www.gimp.com>), under GNU license, which currently deals with GIF, JPEG, PNG, PSD, and TIFF formats. There are

almost comprehensive lists about this kind of programs on the Internet, whatever your O.S., and, furthermore, such programs are often pre-installed in a given O.S.

3.2 Vector images

Vector images programs are still more hidden. Some good examples are “LaTeXdraw” (see <http://latexdraw.sourceforge.net>) and “Xfig” (consider <http://www.xfig.org/>).

4 Conclusion

People must be aware of the different image formats, and their main properties, to enjoy a maximum the digital Computer-Assisted Publication (C-AP).

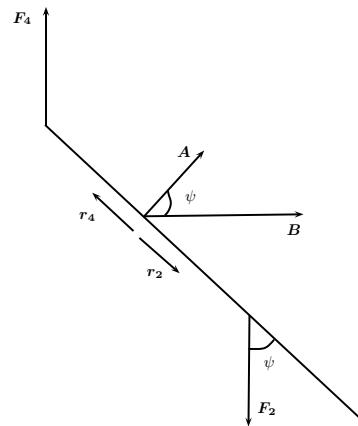


Fig. 1. Equivalent of a vector image.

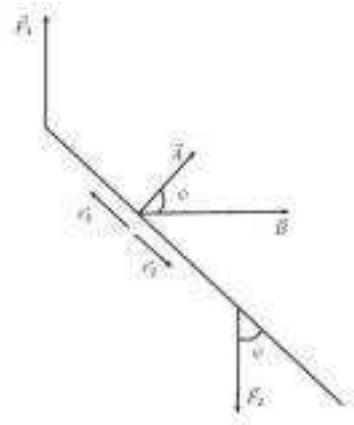


Fig. 2. Equivalent of a raster image.